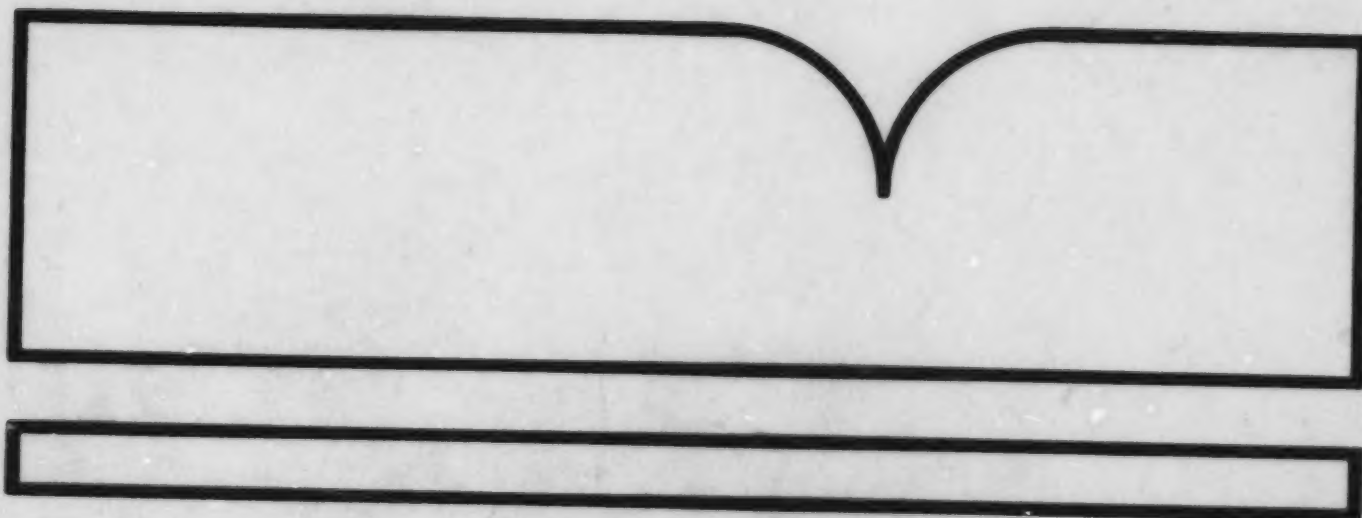


Sources of Toxic Pollutants Found in
Influents to Sewage Treatment Plants
V. Hartford Water Pollution Control Plant
Hartford, Connecticut

(U.S.) Environmental Protection Agency
Washington, DC

Nov 79





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SOURCES OF TOXIC POLLUTANTS FOUND IN INFLUENTS
TO SEWAGE TREATMENTS PLANTS

V. Hartford Water Pollution Control Plant
Hartford, Connecticut

Final Report On
Task Order No. 13
EPA Contract No. 68-01-3857

by
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We wish particularly to thank the large number of Arthur D. Little, Inc. staff members who participated in the sampling and analysis team efforts. Their commitment to the program and their extra hours effort helped make the study a success. The willing cooperation of the corporate facilities staff also helped considerably with the intense start-up effort required for this study.

I. SUMMARY

This report represents the fourth in a series of studies of drainage basins undertaken to determine the relative importance of major sources of pollutants found in the influent of publicly-owned treatment works (POTWs). The general categories of residential, commercial and industrial have been identified as appropriate source classifications. This is the fifth report in the series--the four previous reports (with the same overall title as this report) have been published under the subtitles listed below:

- Part I: Literature Review
- Part II: Muddy Creek Drainage Basin, Cincinnati, Ohio
- Part III: Coldwater Creek Drainage Basin, St. Louis, Missouri
- Part IV: R. M. Clayton Drainage Basin, Atlanta, Georgia

This fourth study was carried out in the drainage basin of the Hartford Water Pollution Control Plant (WPCP) in Hartford, Connecticut. For the most part, this drainage basin provided the opportunity to sample an area comprised largely of commercial and residential flow, with minimal industrial interference. The sampling sites did include a downtown site, similar to the downtown site in Atlanta, which contained a minor industrial park.

Based on water use records, the following relative flows from the different source types in the Hartford WPCP basin were determined by the Hartford WPCP personnel:

Residential:	71.0%
Commercial:	21.5%
Industrial:	7.5%

Thirty-eight (38) percent of the flow to the treatment plant was monitored during this study; the percentages of the sampled flow attributable to each category were as follows:

Residential:	72.5%
Commercial:	24.0%
Industrial:	3.2%

Samples (48-hour composites) were taken from 4 residential sites, 2 commercial sites, 1 downtown area, 2 tap water sources and the POTW influent. The difference between the Hartford WTCP treatment area and the previously sampled, more industrial treatment area, is clearly evident in the frequency and intensity of the pollutant observations. There were very few pollutants observed in more than 50% of the samples at concentrations above 10 µg/L.

Three of the samples collected in Hartford were worked up as QC/QA samples. The QC samples, including the two field blanks totaled 17, comprising 40% of the analytical samples. Twenty-eight (28) samples, plus two field blanks, were collected for analysis. Samples were analyzed for all priority pollutants (excluding asbestos) plus manganese, total phenols, total cyanides, the classical parameters of ammonia, TSS, TOC, BOD, COD, and oil and grease, as well as pH and temperature. The quality control program used in the previous cities was retained for this city.

In the Hartford WTCP drainage basin, 35 pollutants were observed: 22 organics, 10 metals plus manganese, total cyanides and total phenols. The six classical parameters measured in this study--ammonia, TSS, TOC, COD, and BOD, and oil and grease--were also detected. Four (4) metals and total phenols were observed more than 50% of the time (14 samples); copper was observed 100% of the time. Chloroform and 1,1,2,2-tetrachloroethylene were the most commonly detected organics, as they were in Cincinnati, St. Louis, and Atlanta.

There were four organic priority pollutants (4-chloro-3-cresol, nitrobenzene, 1,2,4-trichlorobenzene, fluoranthene) observed in Hartford samples for the first time in this study. All were detected with low frequency and at levels near the reporting limits. There were 91 priority pollutants (including all the pesticides) which were not detected in any of the samples. A detailed discussion of all these results, including source type determination for the various chemicals, can be found in Section VI of this report.

The areas sampled in Hartford included residential and commercial activities, as well as an entire downtown area representing about 25%

of the sanitary flow to the POTW. For the most part, this complex downtown site turned out to have pollutant concentration levels comparable to, or slightly higher than, the other commercial averages and the residential values.

Mass balance analyses were carried out for 18 priority pollutants plus the six classical parameters; only 17 of these 18 have been included in the source studies since bromodichloromethane was observed in the tap water exclusively. Ten (17) of the 17 pollutants and all 6 classicals project a total loading which is equivalent to the measured POTW influent, within a factor of two. Six (6) pollutants have projected source sums less than the mass flow at the influent, and one organic pollutant exhibits a source sum greater than the influent. These results are presented in Table 18.

By comparing the scaled Kg/day values for the residential and commercial sources as fractions of the sum, the following assignments may be made; 3 organics, 6 metals, total phenols, and 3 classicals are predominantly due to residential sources; 4 organics and 2 metals are attributable to commercial activity; butyl benzyl phthalate and oil and grease have no predominant source. Details on sources of pollutants are given in Table 19.

The chemical analysis procedures have been improved substantially for most pollutants. The purge and trap GC/MS method for analyzing the volatile pollutants was modified for the Hartford study. The sorbent trap was altered by completely removing the silica gel and using charcoal in addition to the Tenax. This procedural change led to the successful analysis of chloromethane, dichlorodifluoromethane, bromomethane, vinyl chloride and chloroethane, each of which could not be analyzed by the original EPA method.

The quality control program continues to be invaluable in terms of daily checks on the chemical analyses and in terms of establishing the reliability of the data for subsequent calculations and projections. Most recovery values for the QC samples are in the 70% to 100% range, and the variance in the precision is about 10% to 30%. The QC program

documents the improvement in the volatile analysis where the recovery is generally 90% or more, and the percent deviation for all but the most volatile species is less than 10%.

The selection and isolation of sampling areas containing only one type of source activity, i.e., residential, commercial or industrial, continues to be problematic. The collection system often bears only limited resemblance to the surface zoning and due to the fact that a number of agencies are involved, the system maps frequently are not complete relative to direction of flow and location of manholes. A great deal of site preparation must be put into accurately locating areas whose land use is satisfactory for source type characterization.

During the Hartford study, a decision was made to experiment with alternate flow measurement techniques due to suspected inaccuracies of the periodic depth of flow/Manning equation measurements used previously. The basis of this suspicion was twofold: a lack of correlation between the percentage of inhabited land samples and the percentage of the total flow to the treatment plant that had been accounted for, and a direct comparison of measured flows in previous cities with the "theoretical flows" generated from water billing records and population data for each of the sites. Three alternate experimental techniques were employed, and it was determined that flow could be most accurately measured by using a combination of depth of flow and measured velocity. These experiments and calculations are described in detail in Section IV.

In addition to the 28 analytical samples collected in Hartford, aliquots were taken at the combined sewer sites (Franklin, Potter and POTW) during a period of rain in order to evaluate the runoff effect at these sites. The rain samples were analyzed for six metals - chromium, copper, lead, manganese, nickel and zinc. Mass flow data for the rain samples were compared with mass flow data for periods before and after the rain. A rainwater effect was apparent for lead and zinc and slightly less certain for manganese. The effects are most prominent at the downtown site where automobile activity (most likely responsible for these pollutants) would be expected to be heavy. Further discussion on these effects can be found in Section VI.

II. INTRODUCTION

It is the concern of the Office of Water Planning and Standards (OWPS) to develop a comprehensive strategy governing the toxic substances introduced into, and subsequently passing through, the publicly-owned treatment works (POTWs). In order to supply the necessary basis for formulating guidelines, the Monitoring and Data Support Division (MDSD) has sponsored this study of drainage basins across the country. In addition to assessing the extent to which priority pollutants may enter the environment via the POTWs, this POTW program is concerned with determining the sources of those pollutants. The objectives of the POTW source survey include defining the various types of source categories, describing those categories in terms of priority pollutant contributions, and determining the relationship of the individual source measurements to the pollutant burden at the POTW influent.

By using the data to calculate a set of pollutant specific indices corresponding to the residential, commercial and, to a lesser extent, industrial sources for each of the cities sampled, it is hoped that a general characterization of the pollutant load attributable to these categories can be made. The sources of the pollutants measured in the POTW influent of previously unsampled treatment basins may then be estimated in such a way as to suggest valid routes for controlling pollutant loads.

The sampling and analysis procedures employed in the POTW surveys are those outlined in the EPA Screening Protocol for Priority Pollutants¹ and the EPA Quality Assurance Program.² The first three phases of the sampling and analysis program encompass the studies which were conducted at the Muddy Creek Drainage Basin in Cincinnati,³ the Coldwater Creek Drainage Basin in St. Louis,⁴ and the R. M. Clayton Drainage Basin in Atlanta.⁵ An extensive quality control program was established as part of the initial study, and the data from the following surveys have been shown to be in control. This report documents the survey conducted at the Hartford Water Pollution Control Plant (WPCP) in Hartford. The procedures employed for the sampling and chemical analysis were generally the same as those used in the previous studies.

The area serviced by the Hartford WPCP is predominantly of a commercial and residential nature. In contrast to St. Louis and Atlanta, the industrial component in Hartford was not sufficiently confined to areas segregated from commercial and residential flows to permit the sampling of an industrial source. The basin does have a total industrial contribution, based on water use records, of 7%; most of this is metallic processing and handling. The downtown site in Hartford (Potter St.) encompasses a minor industrial part; this site is, however, classified as commercial and for the purposes of mass flow calculations, the industrial flow has been included with the commercial flow. Further analysis of the Hartford drainage basin is contained in the overall report,⁶ where the average indices of the four drainage basins are used to estimate the industrial pollutant burden at a POTW.

Samples were collected every four hours from 4 residential sites, 3 commercial sites, the POTW influent, and 2 tap water sources. Three 48-hour flow-composited samples were produced for the sites; two were produced for each tap location. Four-hour samples were also taken from the combined sewer locations during a period of rainfall in order to evaluate the runoff contribution at these sites.

This report is restricted to a presentation and discussion of the Hartford study. Since this is the fourth drainage basin in the series to be sampled, there has been a large amount of data generated on the pollutants and possible sources of contamination. The data from this survey at the Hartford drainage basin will be combined with the data from the other surveys, in a final overall report, in order to be able to predict the levels and sources of pollutants found at a POTW serving a "typical" drainage basin.

The frequency of occurrence of a particular priority pollutant at the individual sampling locations has been established from the concentration data. The concentration data have also been used, as in the St. Louis and Atlanta surveys, to develop indices by which the mass load resulting from residential or commercial activities could be determined for each pollutant. These indices were calculated on a mass per capita

basis for the residential sources and a concentration basis for the commercial sources. In this way, the individual measurements could be scaled up to estimate the total pollutant load at the POTW influent.

Each basin surveyed provides an enormous amount of new information. In addition to supplying data on a fourth POTW treatment area, this survey at the Hartford WPCP has served as a measure against which to compare and verify the quality control program as well as a means for testing some of the conclusions that were made based on the previously available data. Since the Hartford sites contained little or no industrial activity, the data can be used to corroborate some of the source assignments made in previous studies, as well as contribute further to the indices to be used in looking at other basins.

III. HARTFORD WATER POLLUTION CONTROL PLANT TREATMENT AREA

A. Introduction

The Hartford Water Pollution Control Plant (WPCP) treatment area--located in metropolitan Hartford, Connecticut--was selected as the fourth test facility for review in the study of the sources of toxic pollutants found in influents to sewage treatment plants for several reasons:

1. The treatment area represented a large basin which was principally comprised of residential and commercial activity. This facilitated the selection of remote sampling sites that were comprised of totally residential or commercial activity, thus enabling the assessment of their pollutant burden without the influence of industrial components.
2. The basin encompassed a major downtown area which allowed for a comparison of data generated in Atlanta with another zone of comparable characteristics.
3. The geographical location (northeast) of the basin represented an area not previously studied in prior surveys.
4. The selected sampling locations were felt to be safe and accessible 24 hours a day.
5. During the preliminary meetings, representatives of the Hartford Metropolitan District Commission staff had indicated that they would be very willing to participate in and support this effort.
6. The Hartford WPCP was also being sampled in a related study conducted by EPA/EGD and Burns and Roe.

Arthur D. Little, Inc. staff visited with the following personnel at the Metropolitan District in Hartford:

Mr. Neil Geldof, Senior Engineer, Department of
Engineering and Planning

Mr. Raymond Markunas, Associate Engineer, Department of Engineering and Planning

Mr. Guy LaBella, Associate Engineer, Department of Engineering and Planning

Mr. Michael Reardon, Operations Engineer, Department of Sewer Operations

The above MDC staff were very cooperative and spent much time and effort in providing the required information regarding both the demographic data and data pertaining to the POTW area, sewer systems, etc.

From information available from the MDC, the following demographic data were obtained for each sampling area:

Housing--number of single family and apartment units for each site and entire POTW area.

Population--population broken down by single family population and apartment unit population for each site and entire POTW area.

Commercial--summary of the number and type of establishments found in these areas. For Clover, the average number of employees for the year 1978 was also available.

Approximate assignments for municipal/public buildings, schools, churches, medical buildings and open land areas were made from land-use maps.

In the following sections, the treatment area and each sampling area are described. Details of the sampling plan are presented in Section IV.

B. Hartford Water Pollution Control Plant

The Hartford WPCP was completed and went into operation in 1938. The plant is located in the southeastern corner of the City of Hartford and is bordered by the Hartford-Wethersfield city line to the south and the Connecticut River to the east. It serves a 93 square mile area comprised of all or part of six communities. Approximately 45 million gallons per day of wastewater are treated within the plant, with an estimated industrial loading of 7 percent. The average strength of the

influent water is listed as 115 mg/L for BOD and 131 mg/L for TSS; during the sampling period, the average values were 71 mg/l for BOD and 104 mg/L for TSS.

The plant is designed to provide secondary treatment for an average daily influent rate of 60 MGD using the activated sludge process. Major unit operations within the plant include primary and secondary settling, biological oxidation, and chlorination. Sludge disposal is performed by incineration at a central facility (on site) where wastes from three MDC plants are processed. Generally, removal efficiency for BOD is between 90 and 96% and between 77 and 92% for TSS; removal efficiencies during the period of sampling activity were 95.6% for BOD and 92.2% for TSS.

The basin's collection system is comprised of both sanitary and combined sewer lines. Wastes enter the plant through one of two major interceptors, of which the one running northward, parallel to the Connecticut River, is the largest. Final discharge of the treated effluent is to the Connecticut River.

C. General Description of the Hartford WPCP Treatment Area

The Hartford WPCP basin encompasses all or part of six communities including the City of Hartford and the towns of Bloomfield, Windsor, Wethersfield, Newington, and West Hartford. Of these communities, the first five are charter members of the Hartford Metropolitan District Commission, with West Hartford being charged on the basis of flow. The drainage basin itself covers approximately 93 square miles of area, of which metropolitan Hartford accounts for 18.4 square miles. The estimated population of the area is 285,000 (1978 estimate). The major commercial area contained within the basin is located in "downtown" Hartford, with smaller commercial zones (shopping malls) isolated within West Hartford and Bloomfield. The breakdown of the housing units and populations in the various communities serviced by the Hartford WPCP is given in Table 1.

The industrial component of the area is scattered throughout the basin, with the highest concentration being on the Hartford-West Hartford border where Interstate 84 crosses. Figure 1 outlines the main roads

Table 1

POPULATION AND FAMILY UNITS IN COMMUNITIES SERVICED BY THE HARTFORD WPCP

<u>Town/City</u>	<u>Type of Occupancy</u>	<u>Sewered Family Units</u>	<u>Sewered Population</u>
BLOOMFIELD	Single Family	3794	13,279
	Apartments	1248	3,119
	Total	5042	16,398
HARTFORD	S.F.	7218	23,098
	Apt.	51015	127,237
	Total	58232	150,335
NEWINGTON	S.F.	6466	22,631
	Apt.	2035	4,884
	Total	8501	27,515
WETHERSFIELD	S.F.	3104	10,553
	Apt.	464	928
	Total	3568	11,481
WINDSOR	S.F.	3804	13,693
	Apt.	614	1,411
	Total	4418	15,104
W. HARTFORD	S.F.	16937	55,892
	Apt.	3849	8,467
	Total	20786	64,359
Totals	S.F.	41323	139,146
	Apt.	59224	146,046
	Total	100547	285,192

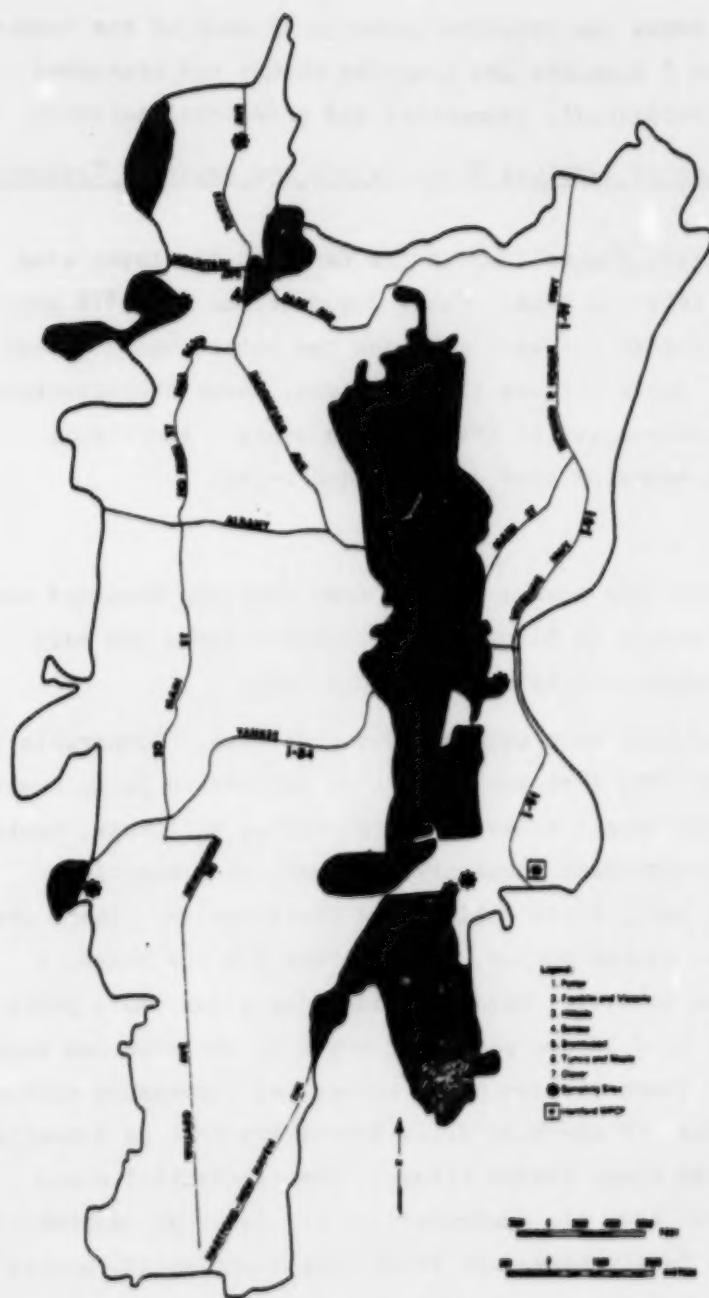


FIGURE 1 HARTFORD WATER POLLUTION CONTROL PLANT TREATMENT AREA

within the basin, and shows the relative location of each of the remote sampling zones. Figure 2 displays the land use within the treatment area with respect to residential, commercial and industrial activity.

D. Overall Description of Sampling Sites Within the Hartford Treatment Area

As mentioned earlier, Figure 1 shows the Hartford treatment area and location for each sampling area. Table 2 summarizes the 1978 population and housing estimates for each area and the entire basin served by the Hartford WPCP. Table 3 lists the locations, sewer characteristics, and general land use designation of the sampling areas. Individual land use maps for each sampling area are included below.

1. Potter

The Potter sampling area covers an area from downtown Hartford north to include a portion located in Bloomfield. Figure 3 shows the main streets, sampling location, and land use of this area.

Potter is characterized as a combined downtown area. Comparable to the downtown area of Atlanta (Peachtree), Potter includes a large commercial component with many retail establishments, office buildings, banks, a few large hotels and apartment complexes, and many city/municipal buildings such as City Hall, State Capitol and Civic Center. There are two hospitals, a mental health center, an institute for the blind, a college, and many other schools. Open land includes a few small parks near downtown, as well as a larger park just north of the downtown area, and a few cemeteries. There are two minor industrial components within this area; one is located at the Blue Hills Industrial Park in Bloomfield and the other is located along Granby Street. The residential areas surrounding the downtown area are characterized as old urban residential. There are 3,405 single family homes and 24,014 apartment units, mostly consisting of multi-family structures, for a total 1978 population estimate of 70,931. There are many ethnic neighborhoods, large housing projects and some rundown neighborhoods. There are scattered old commercial establishments, gas stations, etc.

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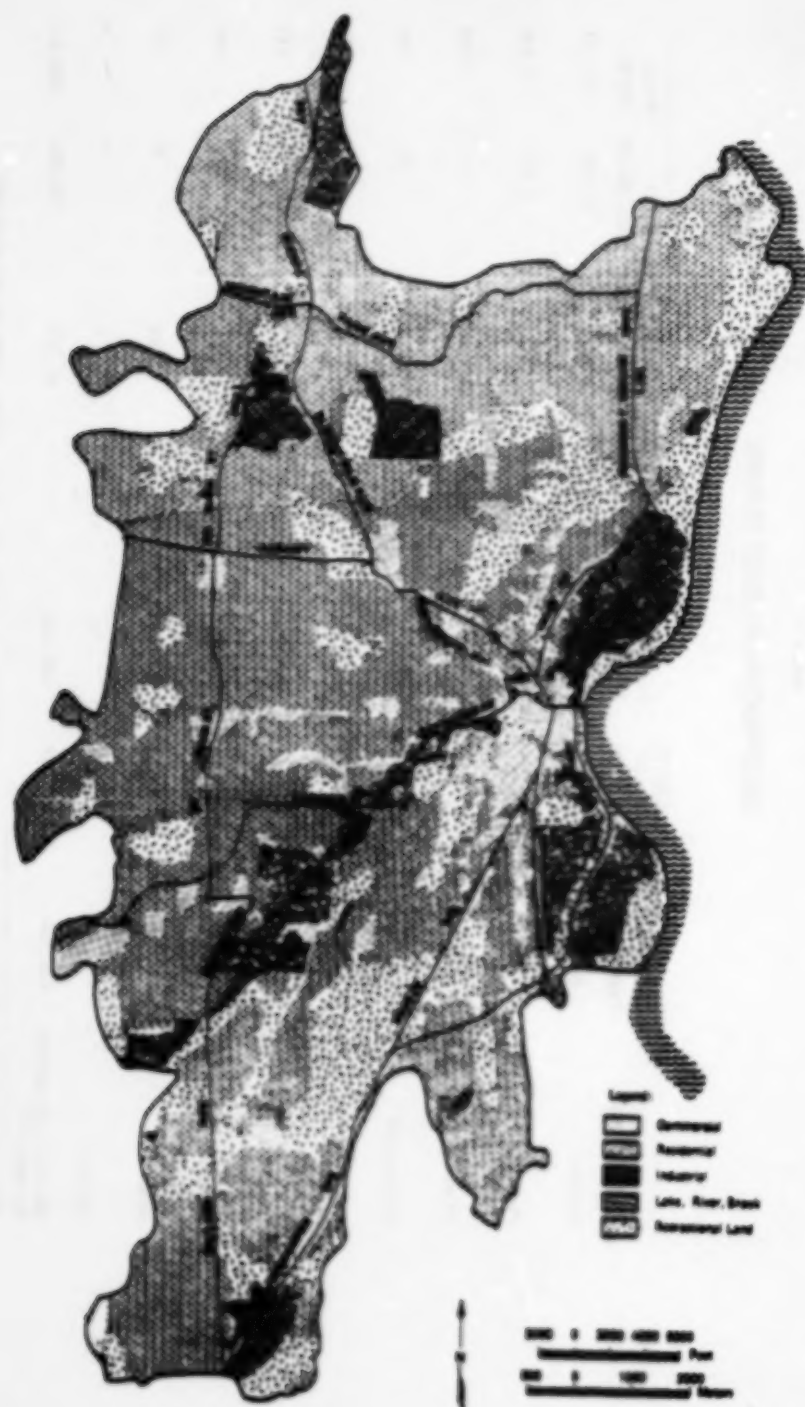


FIGURE 2 HARTFORD WATER POLLUTION CONTROL PLANT TREATMENT AREA - LAND USE

Table 2

1978 POPULATION AND HOUSING ESTIMATES

SAMPLING AREA	POPULATION		Type of Occupancy and Persons Per Unit ^a	HOUSING		
	Single-Family Population	Apartment Population		No. Single Family Homes	No. of Apt. Units	Total Units
Potter	10,895	60,036	S. 3-2 A. 2-5	3,405	24,014	27,419
Franklin	3,071	16,924	S. 3-2 A. 2-5	960	6,770	7,730
Victoria	9,839	928	S. 3-4 A. 2-0	2,893	464	3,357
Millington	1,838	474	S. 3-2 A. 2-5	575	190	765
Maple	595	0	S. 3-5 A. 2-5	170	0	170
Tunica	690	0	S. 3-5 A. 2-5	197	0	197
Beaumont	1,387	130	S. 3-5 A. 2-5	399	52	451
Sumner	53	240	S. 3-5 A. 2-5	15	96	111
Clower	14	0	S. 3-5	4	0	4
Racine area served by MRC ^b	139,144	144,046	-	41,323	59,224	100,547

^aDistribution of people living in single family units and apartment units is that used in the 1978 MRC Annual Report. ^bEstimated Sumner Family Units and Population in the Metropolitan District - By Yount.

^cHouseing estimated on 252 units in apartments and 752 in single family.

^dData obtained from the 1978 MRC Annual Report.

Table 3

SAMPLING HOLE LOCATIONS AND CHARACTERISTICS

Code Name	Source type/Sewer type	Location (Longitude:Latitude)	Sewer Characteristics
Franklin	Old residential/combined	72° 40' 23.8"	72" brick and reinforced concrete
		41° 43' 46.1"	0.39% slope
Victoria	Old residential/combined	72° 40' 46.2"	30" reinforced concrete
		41° 43' 37.9"	0.08% slope
Hillside	Old residential/sanitary	72° 41' 49.1"	18" tile
		41° 43' 54.8"	0.2% slope
Clover	Commercial/sanitary	72° 45' 38.2"	12" tile
		41° 43' 17.8"	0.3% slope
Potter	Commercial/combined	72° 40' 10.5"	56" brick
		41° 45' 44.2"	0.15% slope
Seneca	Commercial/sanitary	72° 43' 57.2"	8" asbestos cement
		41° 49' 46.5"	2% slope
Tunika	New residential/sanitary	72° 44' 34.3"	24" reinforced concrete*
		41° 51' 43.8"	0.1% slope
Maple	New residential/sanitary	72° 45' 1.7"	12" asbestos cement*
		41° 49' 30.7"	0.4% slope
Brentwood	New residential/sanitary	72° 43' 55.4"	12" asbestos cement
		41° 49' 49.2"	0.5% slope

* All pipes less than 12" diameter are PVC pipes.



FIGURE 3 POTTER - LAND USE AND STREETS

2. Franklin and Victoria

This sampling area includes two separate sections near the Hartford and Wethersfield border: Franklin is located in Hartford just south of the Potter-downtown sampling area, and Victoria is located just over the Hartford-Wethersfield town line in Wethersfield, south of the Franklin site. Figure 4 shows the land use, sampling locations, and main streets for these areas.

Franklin and Victoria are both characterized as old residential, with most of the homes being 50+ years old and consisting mostly of apartments, "triple-deckers" and other multi-family units. The Franklin sampling area, a highly ethnic neighborhood, contains 960 single family residences and 6,770 apartment units with a 1978 total population estimate of 19,995. There are some sections containing unused, rundown or boarded up buildings. The old commercial establishments are found mostly along Maple Avenue and Franklin Avenue and include restaurants, bakeries, package stores, and drug stores. Also included is the Hartford Hospital, the Institute for Living, and two schools.

Victoria contains a large, old residential area containing 2,893 single family homes and 464 apartment units for a total 1978 population estimate of 10,767. Town/municipal buildings include the Highway Department, Labor Department, a community center, and a school. Open land includes a large cemetery area and a recreation area (Wintergreen Woods). There are scattered commercial establishments.

3. Hillside

The Hillside sampling area is located in Hartford, north of Wethersfield and adjacent to the Franklin sampling area. Figure 5 shows the main streets, sampling point, and land use for this area.

Hillside is characterized as old residential, about 40-50 years old. There are 575 single family residences and 190 apartment units with a total 1978 population estimate of 2,312. The non-residential activity is very minor; there are only a few corner stores scattered throughout the neighborhood, a playground, and no public or municipal buildings.



FIGURE 4 FRANKLIN AND VICTORIA – LAND USE AND STREETS

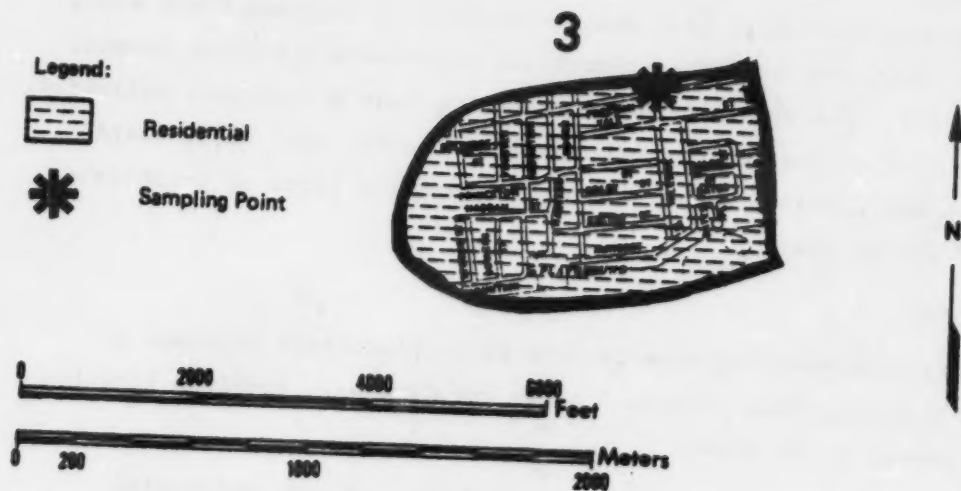


FIGURE 5 HILLSIDE—LAND USE AND STREETS

4. Seneca

The Seneca sampling area is located in Bloomfield, north of West Hartford and adjacent to the Brentwood sampling area. Figure 6 shows the land use, sampling location, and main streets in the area.

The Seneca sampling area is characterized as commercial. There are only 15 single family homes and 96 apartment units with a total 1978 population estimate of 293. Most of the commercial establishments are found in the Wintonbury Mall and the Bloomfield Shopping Plaza along Park Avenue, with some scattered commercial establishments along Seneca, Jerome and Park. The area includes most of the town's municipal buildings, including a post office, police and fire departments, town hall, board of education and library. Table 4 characterizes the types of establishments found in the area.

5. Brentwood

The Brentwood sampling area is located in Bloomfield adjacent to the Seneca sampling area. Figure 7 shows the land use, sampling location and main streets in the area.

The Brentwood sampling area is characterized as new residential with no commerce. There are 399 single family homes and 52 apartment units for a total 1978 population estimate of 1,527.

6. Tunxis and Maple

This sampling area is located in Bloomfield and is comprised of two section: Tunxis and Maple. Figure 8 shows the land use, sampling locations and main streets in these areas.

The Tunxis sampling area is characterized as new residential with 197 single family homes, no apartment units, with a 1978 population estimate of 690. The area includes a large tract of land for town recreation, the Tunxis reservoir and part of Tunxis Flood Water Retarding Dam, a small pond, and streams.

The Maple sampling area is new residential with 170 single family homes, no apartment buildings, and a 1978 population estimate of 595.

Legend:



Commercial



Residential



Sampling Point



FIGURE 6 SENECA—LAND USE AND STREETS

Table 4

COMMERCIAL CHARACTERIZATION OF SENECA

15 single family
96 apartment units
Population: 293

Wintonbury Mall

2 banks	4 clothing stores
2 restaurants	1 gift shop
1 book shop	1 tool distributor
1 figure salon	1 corporate office
1 barber shop	1 optometrist
1 package store	1 rating bureau
1 photographer/jeweler	1 mort/finance co.
1 shoe store	1 insurance agency
1 pharmacy	2 large law offices
1 copying service	

Bloomfield Shopping Plaza

2 restaurants	1 photographer
1 insurance agency	1 grocery store
1 tour agency	1 dentist
1 pharmacy	2 clothing stores
1 cleaner/laundrer	1 barber
1 footwear	1 beauty shop
1 flower shop	1 bike shop

Shopping area adjacent to Bloomfield

1 grocery store	1 cleaners
1 drug store	1 beauty shop
1 restaurant	

Other Scattered Commercial

2 gas stations	1 restaurant
1 hardware store	1 funeral home
1 farmer's exchange	1 jeweler
2 banks	1 RE/Ins/Law office building
1 theatre	1 medical office building

Municipal Buildings: post office, police depart., town hall, board of education, fire department, town green, library

Religious: Sacred Heart Church and School, Congregational Church

Legend:



Residential



Sampling Point



FIGURE 7 BRENTWOOD—LAND USE AND STREETS

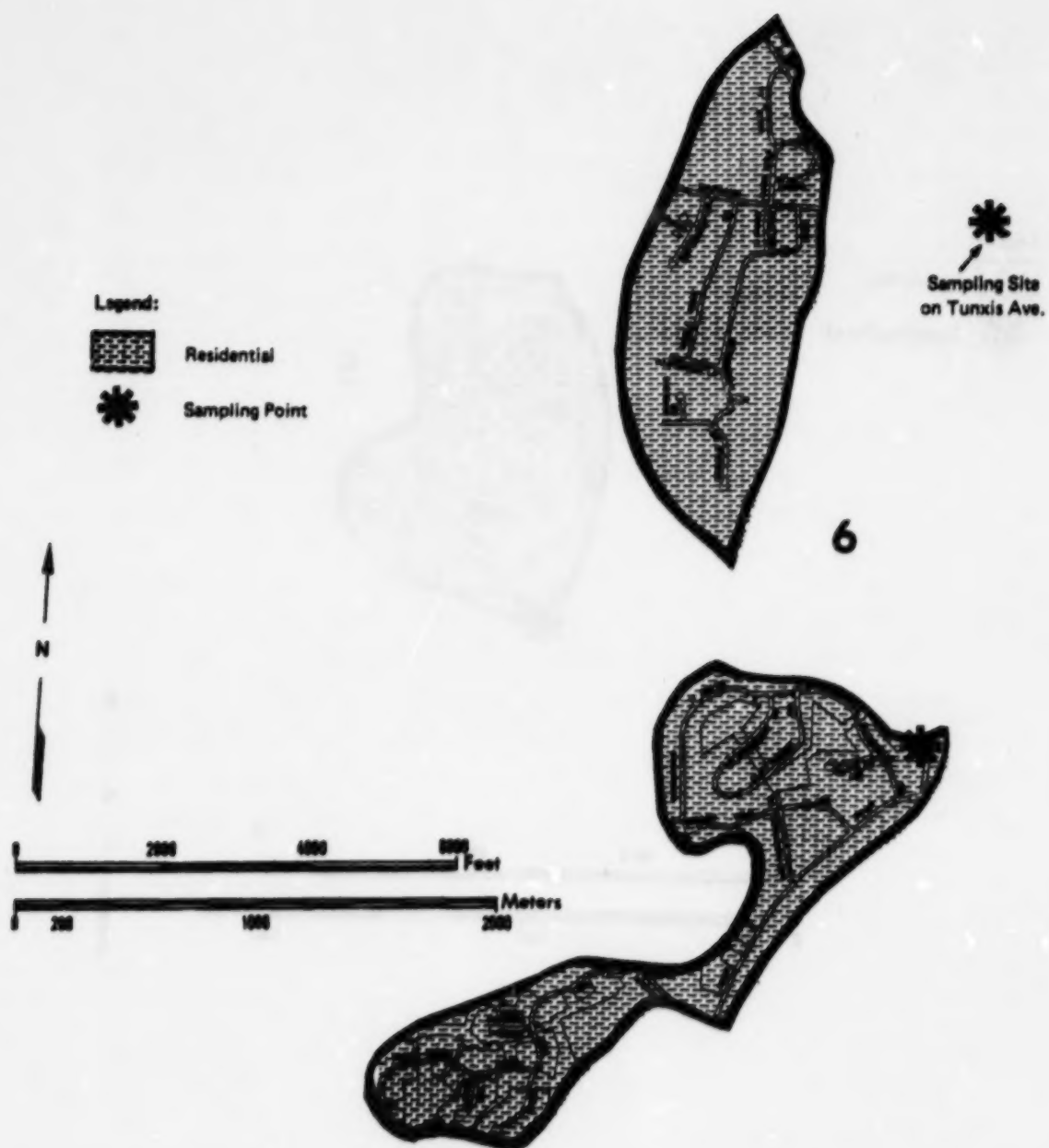


FIGURE 8 TUNXIS AND MAPLE—LAND USE AND STREETS

The area includes the Cold Spring Flood Water Retarding Dam. To the south, the area borders the MDC Reservoir #6 Water Treatment Plant.

7. Clover

The Clover sampling area consists mostly of the West Farms Mall which is located on the Farmington/West Hartford town line. Approximately 40% (423,121 sq ft) of the total building square footage is assessed by the town of West Hartford and 60% (618,833 sq ft) is assessed by the town of Farmington. Figure 9 shows the main streets, land use, and sampling point in this area.

There are 122 commercial establishments within 1,041,954 sq ft of building area. The average number of employees during 1978 was 1,798. Table 5 lists the numbers and types of establishments and average number of employees for the year 1978.

8. Tap

Tap water samples were taken from two locations within the Hartford WPCP treatment area corresponding to two different water supplies. One (1) sample was obtained at the treatment facility, while the other was obtained from a tap located in the town green in Bloomfield, Connecticut (Wintonbury tap).

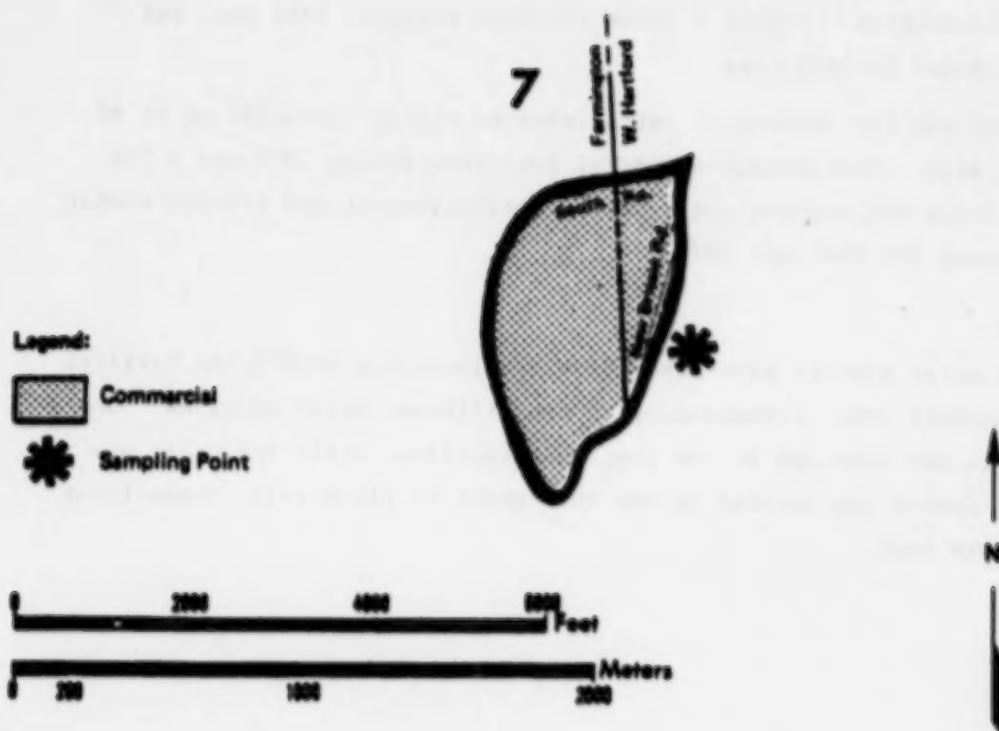


FIGURE 9 CLOVER - LAND USE AND STREETS

Table 3

COMMERCIAL CHARACTERIZATION OF CLOVERWest Farms Mall

<u>Total No.</u>	<u>Type of Establishment</u>	<u>Average Number of Employees for Year 1978</u>
15	Restaurants	300
6	Food stores	26
42	Clothing stores	1075
3	Bookstores	16
12	Shoe stores	64
1	Liquor store	3
6	Gift stores	38
3	Opticians	24
2	Banks	6
7	Jewelers	53
1	Drug store	12
1	Pet center	9
4	Music stores	19
1	Beauty shop	8
1	Sporting goods	33
1	Theatre	18
1	Home furnishings	4
1	Travel	2
1	Mgmt service	48
13	Misc. retail	40
122	Total of Avg. Number of Employees During 1978	1798

IV. SAMPLING PROCEDURES

A. Sample Collection

For the most part, all aspects of the sampling procedures used in Hartford were comparable to those which had been used in the previous three cities.^{3,4,5} As before, sample collection was performed utilizing a manual collection technique in which a two-liter stainless steel graduate (bucket) was repeatedly lowered into the flow of wastewater to fill the required number of sample bottles.

All of the actual collection procedures were identical to those previously employed in the other cities. Upon arriving at each sampling site, the field crew would first measure the temperature, pH and oxidizing potential of the wastewater (with potassium-iodide starch paper) and then collect the required amount of wastewater as identified on a chart within the field sampling procedures manual (see Appendix A). The necessary volume of each sample increment was calculated to insure that adequate volume was collected each time to allow for accurate flow compositing over a flow variation of up to five to one (5:1). Using this protocol, the final volume of wastewater collected was sufficient to produce a final "sample" that was made up of those fractions listed in Table 6.

There were two significant differences between the Hartford study and the Cincinnati and St. Louis studies: as had been the case in Atlanta, a forty-eight (48) hour compositing period was used for each sample; for each of two of the composited samples (Tunxis and Franklin), wastewater was obtained from two distinct sampling locations. The principal reason for extending the compositing period from twenty-four to forty-eight hours was to continue to allow for obtaining samples from a variety of area types (residential, commercial, etc.) without dramatically increasing the total analysis costs. Similarly, the decision to combine four sampling locations into two final samples (Tunxis and Maple = Tunxis, Franklin and Victoria = Franklin) arose because of the desire to limit the total number of samples analyzed, while still obtaining wastewater from approximately 15 to 20 percent of the land mass in the basin. Since similar

Table 6

SUMMARY OF FINAL SAMPLE FRACTIONS AND THEIR REQUIRED VOLUMES

<u>Priority Pollutants</u>	<u>Code</u>	<u>Normal Sample</u>	<u>QC'd Sample</u>
• Acid/Base Neutral fraction	(ABN)	2L	6L
• PCB/Pesticide fraction	(PCB)	1L	3L
• Total Phenol fraction	(Phen)	1L	3L
• Cyanide fraction	(CN)	1L	3L
• Metal and Mercury fraction	(M+,Hg)	1L	3L
• Asbestos fraction	(As)	1L	3L
• Volatile Organic fraction	(VOA)	45mL	45mL
<u>Classical Parameters</u>			
• Ammonia	(NH ₃)	1L	1L
• Chemical Oxygen Demand	(COD)	500mL	500mL
• Total Organic Carbon	(TOC)	500mL	500mL
• Biological Oxygen Demand	(BOD)	1L	1L
• Total Suspended Solids	(TSS)	1L	1L
• Oil and Grease	(O+G)	1L	1L

demographic and plumbing characteristics were present within the Tunxis and Maple (new residential, sanitary waste only, predominantly PVC pipe), and Franklin and Victoria (old residential, combined sewers, concrete pipe) areas, the combination of each of these pairs allowed for the fulfillment of both desires.

Subsequent to the completion of all the sampling steps (including collection, labeling, preservation, clerical documentation and packing), the volume of wastewater passing through the sampling site was determined. As before, the depth of flow was measured and a flow rate was obtained by use of the Manning equation. All flow compositing of the collected sample increments was conducted in the laboratory, using the flow rates obtained in this way.

8. Flow Measurements

In addition to measuring the flow of wastewater through each of the selected sampling locations by means of the depth of flow/Manning equation approach, four other flow determination techniques were used during the Hartford evaluation. In specific, a periodic depth of flow/direct velocity determination was used at each of the remote sampling sites, and a continuous depth of flow/Palmer-Bowles flume technique was employed in as many locations as was feasible. Wherever it was impractical to install a flume, particularly in the case of large pipes (i.e., greater than 61 cm [24 inches] which were carrying large volumes of flow), a continuous depth of flow measurement/Manning equation approach was used instead.

In addition to these three experimental flow measurement options, a theoretical flow evaluation of the Hartford WPCF basin was also conducted. As had been the case with both the St. Louis and Atlanta studies, the basis of this theoretical evaluation assumed that each resident within the basin or a specific sampling zone used and discharged water at a rate of approximately 380 liters (100 gallons) per day. Furthermore, the industrial, commercial, municipal, etc., burden was computed on the basis of water billing records, assuming that all water entering a facility was in turn discharged into the collection system. A summary of these data is presented in Table 7.

Table 7

TOTAL THEORETICAL FLOW THROUGH EACH SAMPLING POINT

Location	Theoretical Flow (LPS)			Total
	Residential	Commercial	Industrial	
Franklin including Victoria	134.8	25.9	0.6	161.3
Hillside	10.1	0.3	-	10.4
Clover	0.1	4.0	-	4.1
Potter	310.7	135.2	22.3	468.2
Tunxis including Maple	5.6	-	-	5.6
Brentwood	6.7	-	-	6.7
Seneca	1.3	1.5	-	2.8
Basin excluding above	780.1	212.3	108.4	1100.8
Total Basin Found	1249.4	379.2	131.3	1760
	71%	21.5%	7.5%	

The decision to experiment with these additional flow measurement options arose as a result of the suspected inaccuracies of the periodic depth of flow/Manning equation work which had been used in the previous three cities. As has been mentioned in the previous reports, flow measurements for Cincinnati, St. Louis and Atlanta appeared to produce results which were too high. The basis of this belief was derived from two sources: (1) a lack of correlation between the percentage of inhabited land sampled versus the percentage of the total influent flow to the treatment plant accounted for, and (2) a direct comparison of the measured flows in St. Louis and Atlanta with "theoretical flows" generated from water billing records for each of the sampling sites.

Inasmuch as a good assessment of the actual flow passing through each of the remote sampling sites is paramount to being able to close a material balance about the basin, and to the development of realistic source category pollution indices, it was hoped that the alternative flow measurement procedures would shed some light on the validity of the previously tabulated values. Presuming that the periodic depth of flow/Manning approach was correct, confirmation of this fact should be obtained by reproducing flow values by other means. If, on the other hand, the Manning-derived values were inappropriate, it was hoped that a calibration or correction factor could be derived to adjust the previously acquired data.

Before proceeding with the discussion of alternative flow measurement techniques, it is useful to review the Manning equation to highlight those factors (measurements) which may influence the accuracy of any given value. The Manning equation used to calculate flow is:

$$Q = \left[\frac{(R^2 \cos^{-1} \frac{(R-h)}{R} - (R-h) \sqrt{2Rh-h^2})^{1.667}}{(2R \cos^{-1} \frac{(R-h)}{R})^{0.667}} \right] \frac{S^{0.5}}{N}$$

where:

Q = volumetric flow rate (m³/sec)

R = radius of the pipe (m)

h = measured depth of flow (m)

S = slope of the pipe (m/m)

N = roughness coefficient of the pipe

Through a review of this equation, it becomes apparent that the accurate measurement of flow is dependent upon four variables: pipe slope, pipe roughness, pipe diameter and the measured depth of flow. Of these four variables, the accurate measurement of pipe slope and pipe roughness are perhaps the hardest to experimentally determine. Therefore, in place of experimentally determined values, tabulated figures obtained from sewer line construction plans (pipe slope) and reference books (roughness coefficient) are used. In doing so, however, it must be realized that some error is immediately introduced into the final flow rates obtained.

For example, under some conditions a difference in slope of only one-tenth percent (0.1%) can change the calculated flow rate by as much as forty (40) percent. Since the value for pipe slope which appears on construction plans does not always coincide exactly with what actually exists (due to improper construction, settling, etc.), the possibility of poor slope values is very real. Furthermore, since manholes are frequently installed at a point where a slope change is required (due to land contour changes), it is difficult to determine whether the slope of the inlet pipe, the discharge pipe, the manhole's invert, or some combination of all three values is the most correct value to use.

Comparably, the estimation of pipe roughness from tabulated values, which normally recommends the use of an average value of 0.013, can introduce a large error into the flow measurement value. This is true because pipe roughness coefficients are known to change with the age or condition of the line, as well as with the amount of flow which is being carried.

In selecting alternative flow measurement options, one of the principal factors considered related to the possibility of eliminating the dependence of the final calculation upon the pipe slope or roughness coefficient. In doing so, it became possible to assess the relative accuracy of using tabulated values, making it possible to correct or recalibrate flow rate data tabulated for each of the other cities.

With this in mind, the first alternative approach selected for review employed a Marsh McBirney Model 201 flow meter to directly measure

the average linear velocity of the flowing stream. In operation, this flow meter induces an electromagnetic field about its sensor, which is disrupted as the flowing stream impacts or passes by the probe. The amount of the disturbance is then measured and the difference between what should exist, and what does exist is transformed directly into a linear velocity figure. By positioning the sensor at a point that is approximately 60-66 percent of the actual depth of flow, the average rate of flow within the stream is obtained (based upon a knowledge of fluid mechanics) and an average flow rate may then be obtained by directly multiplying this value by the known (measured) cross-sectional area of flow.

The second alternative flow measurement option employed during the Hartford evaluation also eliminated the dependence on calculated values of pipe slope and roughness factors. Wherever it was possible, appropriately-sized Palmer-Bowles flumes and automatic Manning dippers (F 3000A series) were installed at manhole locations which were either one hold upstream or one hole downstream of the sampling point. The installation of these devices away from the sampling points was required because of the accessibility problems associated with being unable to sample around the mounted equipment. The flow rate information obtained was felt to be unaffected, however, because there was a minimum of sewage connection points between the two locations.

In theory, the installation of a Palmer-Bowles flume allows for the estimation of flow rate by imposing a condition of critical flow at a location of known cross-sectional area. By then measuring the depth of flow at a known point upstream of the flume, it is possible to correlate the depth of a known (calibrated) velocity. Similarly, the measurement of depth at a selected location also sets a cross-sectional area value which, when numerically combined with the velocity measurement, produces a flow rate estimate.

In those locations where the installation of Palmer-Bowles flumes was prohibited (specifically at those sampling points where pipes larger than 0.61 m [24 inches] existed), a Manning dipper was installed to

measure the depth of flow on a continuous basis. While this technique is not independent of pipe slope or roughness coefficients, it was hoped that the continuous measurement of depth would indicate whether the inaccuracy of flow measurements occurred due to the fact that the periodic depth of flow values obtained always represented peak flow values as opposed to average values.

The results of the flow measurements using all of these alternative techniques are presented for review in Table 8.

Before proceeding with a detailed review of the experimentally-derived flow measurements, a few comments should be made relative to the validity of the theoretical flow evaluation conducted for Hartford. As may be seen from the review of data presented in Table 8, the theoretical dry weather flow tributary to the Hartford WPCP is expected to be 1760 Lps, with the sampled locations representing approximately 35-40 percent (660 Lps) of that total. When compared to the average influent flow for the period of the Hartford study (2444 Lps), this indicates that only a 72 percent closure of the flow balance is attained. However, one fact that is overlooked in this analysis is that the ten-day period preceding the sampling activity was extremely wet (17 cm or 6.7 inches of rain) and, therefore, the water table is presumed to have been high during the sampling period. Based on data provided to us by representatives of the Hartford MDC, the collection system of the Hartford plant is known to have an infiltration rate equivalent to roughly 25 percent of the influent during wet periods, which indicates that the real theoretical flow tributary to the plant should be closer to 2200 Lps. This adjusted theoretical flow compares favorably to the observed influent rate and indicates that a 90 percent closure of the flow balance was achieved.

Through a review of the data that is presented within Table 8, it becomes obvious that the flow data derived by use of the depth of flow/Manning equation approach is once again suspect for the Hartford study. The basis of this suspicion again lies in the fact that the summed total of all the independent sites (2150 Lps) represents approximately 88 percent of the daily influent flow average of 36 readings (2444 Lps), whereas the

Table 8

SUMMARY OF FLOW DATA CITY 4 - HARTFORD*

Sample Location	Theoretical Flow (Lps)	Manning Equation (Lps)	Velocity: Depth of Flow (Lps)	Flume: Dipper (Lps)	Dipper: Manning Equation (Lps)
Franklin Victoria	161	755	259	-	880
Hillside	10	27	31	20	-
Clover	4	9	7	10	-
Potter	469	1324	603	-	983
Seneca	3	6	3	5	-
Tunxis Maple	6	19	14	14	-
Brentwood	7	10	10	7	-
Total of Above	660	2150	927	-	-
Influent	1760	2444	2444	2444	2444

* All values are six day averages.

the percentage of land represented by the remote sampling sites only encompasses roughly 15 to 20 percent. The theoretical analysis indicates that the actual (dry weather flow) percentage of the basin represented by the remote sites is closer to 37.5 percent. Even though one of the remote sites (Potter) typifies a highly concentrated area of commerce (core city area), it is not believed that this alone is adequate to explain the noted disagreement. When compared to the theoretical flow rates, all depth of flow/Manning equation values are on the order of 1.5 to 4.4 times too high.

Further review of the data in Table 8 suggests that the flow measurements obtained by the velocity/depth of flow approach agree better with those of the theoretical analysis. As is seen, the sum of all remote sites (927 Lps) represents approximately 38 percent of the averaged influent, which agrees favorably with the 37.5 percent expected from the theoretical analysis. Furthermore, while a comparison of these values to the theoretical flow again indicates that all values are high, the range (between 1.15 and 2.98) is closer to the theoretically derived values than are the comparable depth of flow/Manning equation derived values (1.5 to 4.4). If the effects of infiltration are factored in, the noted range of these values drops to between 0.92 and 2.38.

Similarly, the flow values obtained using the Palmer-Bowles flume/Manning dipper approach are seen to be in better agreement with theoretical values and the velocity based measurements than are the depth of flow/Manning equation values. Once again, the noted range (1.09 to 2.6) of the measured to theoretical values is in better agreement with the theoretical values and the sum total of the five sites where flumes and dippers were used represents 2.3 percent of the influent flow while theoretically they should represent 1.7 percent.

On the other hand, values obtained using the dipper/Manning equation approach (no flume) are no better than those obtained using the depth of flow/Manning equation approach. As is seen with this measurement technique, the two remote sites (Potter and Franklin) apparently account for 78 percent of the flow that is tributary to the plant while theoretically they should only account for 36 percent.

Therefore, as a result of this study, it appears the flows developed using either the velocity/depth of flow technique or the flume/Manning dipper approach are more reliable than those produced using the Manning equation when compared to theoretically derived values. However, due to the fact that considerably more effort is required to install flumes and dippers than is needed to measure flow with the velocity/depth of flow method and that the installation is often prohibited because of physical limitations (sizes larger than 24 inches must be constructed in situ), it appears that any calibration or correction of previous measurements should be performed using the velocity approach. Furthermore, as the correction factor appears to be site specific (i.e., the ratio of velocity/depth of flow measurements to depth of flow/Manning equation measurements is not uniform for all sites), calibration of initially tabulated flows from the other cities should be performed by revisiting each sampling location and obtaining new measurements by both the Manning equation and velocity approaches over a wide range of flows. The correction factor may then be computed as the ratio of the new values.

To illustrate how the recalibration of previously recorded flow data was accomplished, the following example is presented for review. For the sake of brevity, many of the intermediate steps have been eliminated from this example, however, all values can be reproduced using either the Manning equation or simple geometry. For one site in St. Louis, the following information was obtained during preliminary visits.

Pipe diameter = 45.7 cm (18 inches)

Pipe slope = 0.11 percent

Roughness coefficient = 0.0135

Based on depth of flow measurements made during the week of sampling, the following daily and weekly averages had been computed using the Manning equation:

	A	B	C	D	E	F	AVG.
Flow (Lps)	96.6	103.7	99.2	102.8	108.2	121.0	105.4

Upon revisiting this location, the values for depth of flow and linear velocity recorded in Table 9 were obtained. These depth of flow data were then used directly in the Manning equation resulting in the determination of those values listed in the column under "Manning Values." Concurrently, the linear velocity values were multiplied by wetted area measurements (derived from depth of flow measurements and geometry) to produce those values listed under the heading of "Velocity Values." The ratio of the velocity value to the Manning value produces the data recorded under the heading of "Correction Factor."

The average of these independent correction factors is computed, and this value is then multiplied by the initial daily and weekly flow values to produce the corrected flow rates for this site, as are shown below.

DAY	A	B	C	D	E	F	Avg.
Flow (Lps)	34.1	36.6	35.0	36.3	38.2	42.7	37.2

This approach was used for each of the three previous studies and is documented in these reports.^{3,4,5}

Table 9

SUMMARY OF DATA USED TO COMPUTE CORRECTION
FACTOR FOR A ST. LOUIS SITE

<u>Site</u>	<u>Measured Depth (cm)</u>	<u>Measured Velocity (fps)</u>	<u>Manning Value (Lps)</u>	<u>Velocity Value (Lps)</u>	<u>Correction Factor</u>
St. Louis	19.7	2.05	115.9	42.3	0.365
	17.9	2.05	97.3	37.2	0.382
	17.8	1.7	96.3	30.6	0.318
	14.2	1.65	63.0	21.9	0.348
Avg...					0.353

V. CHEMICAL ANALYSIS

A. Chemical Procedures

1. Introduction

The procedures used to analyze samples collected in Hartford were the same as those used for the previous studies. These procedures are described in the EPA Screening Protocol,¹ the EPA Quality Assurance Program,² the Cincinnati POTW report,³ the St. Louis POTW report,⁴ and the Atlanta POTW report.⁵ Chemical analysis of the samples included producing a flow-composited sample from the individual field samples, appropriate sample preparation (extraction, acid digestion, etc.), and subsequent instrumental analysis. D₁₀-anthracene and four "total method" internal standards were added to Hartford samples as described in the Atlanta POTW report.⁵ Details on all the analytical procedures are given in Appendix B.

2. Modified Procedures - Volatiles

The procedure used to analyze the priority pollutants in the volatile category has been modified. The purge and trap, gas chromatography/mass spectroscopy method for analyzing volatile priority pollutants was altered by adding charcoal to the sorbent trap and by completely removing the silica gel. This was done to prevent the gases from breaking through the trap. The procedural change led to the successful analysis of chloromethane, dichlorodifluoromethane, bromomethane, vinyl chloride and chloroethane. Each of these species could not be analyzed using the original EPA procedure.

3. Other Comments

Data on the field blanks can be found in Appendix B. The data indicate that contamination in both the laboratory and the field are in control. The compounds listed below were consistently not detected using the EPA Screening Protocol.¹ These compounds were also not detected during the previous studies.

Standards Not Detected By EPA Method

Base/Neutrals: Bis(chloromethyl)ether
2-Chloroethyl vinyl ether
Hexachlorocyclopentadiene

It is important to note that four compounds -- chloromethane, dichlorodifluoromethane, vinyl chloride and bromomethane -- which previously were not able to be detected using the EPA protocol, were measured in the spiked samples during the Hartford study due to the modified purge and trap method.

The reporting limits for the organic and inorganic priority pollutants can be found in Appendix B. Reporting limits are comparable to those used for the previous studies. Complete data from the chemical analyses have been tabulated by site and chemical compound in Appendices D and E.

B. Quality Assurance/Quality Control

A quality assurance program was employed for this study in order to document the reliability of the data obtained on the priority pollutants found in the samples. The quality control procedures used for this study are detailed in the Cincinnati report.³ The specific quality control (QC) activities for sample analysis were based on the general recommendations published by the Environmental Monitoring and Support Laboratory (EMSL/EPA), Cincinnati, as specifically abstracted for this type of program in the March 1978 document.²

Five samples (representing a range of source types) were chosen as QC samples. Two of these were set aside as contingency QC samples to be used only if procedural difficulties were encountered. The three QC samples that were used generated 15 analytical samples. Including the two field blanks, the total number of samples associated with the QC/QA program was 17, 40% of the total number of samples analyzed. The specific samples associated with quality control activities, as well as the calculations used to determine if the analysis is in control, are described in the Cincinnati and St. Louis reports.^{3,4}

An additional feature of the quality assurance program for the Atlanta and Hartford studies was the use of the four "total method" internal standards that were added to all the acid and base/neutral samples prior to extraction. In this way, quality control data measuring the precision and accuracy of the entire method were made available for all of the samples. Details concerning the internal standards are discussed in Appendix C.

The quantitative results for each pollutant studied are tabulated in Appendix B. QC data were not obtained on two of the compounds, bis(2-chloroisopropyl)ether and 2,3,7,8-TCDD, because it was not possible to obtain reference supplies for these priority pollutants.

There are a few compounds for which the recommended protocol is problematic. Due to the detailed quality control program, these problems could be traced back to specific technical difficulties. One compound that was generally difficult to analyze during the St. Louis, Atlanta, and Hartford studies was benzidine. During the Hartford study, problems were also encountered with the analyses of 2,4-dinitrophenol, 4,6-dinitro-2-cresol and 4-nitrophenol. It is believed that poor chromatography on the acid GC column was responsible. Detailed information concerning these analytical problems can be found in Appendix B.

For convenience in reviewing the data, Table 10 has been prepared summarizing the overall results achieved within each of the analysis categories for Hartford QC samples. Most recovery values are in the 75% to 100% range, and the precision ranges from 2% to 20%. Those data, especially the precision data, show the continued, gradual improvement in the quality of the data which has been accomplished during these studies.

For the acid analysis, the average recovery for the "total method" internal standards -- 2-fluoronaphthalene, octafluorobiphenyl and decafluorobiphenyl from raw wastewater samples (A, B, C) -- was approximately $66\% \pm 16$. For the base/neutral analysis, the average recovery for the four "total method" internal standards (9-phenylanthracene was also measured) was $86\% \pm 11$. These data indicate that the "total method," as used in Hartford, was in control for all samples analyzed.

Table 10

SUMMARY OF QUALITY ASSURANCE DATA

Category	Average Spiking Level, $\mu\text{g/L}$	Method Reference ^a		Raw Wastewater ^b	
		Average Recovery	Average Standard Deviation	Average Recovery	Average Standard Deviation
Volatiles	20	104	± 8	109	± 14
Acids	50	81	± 10	78	± 15
Base/Neutrals	50	76	± 11	66	± 12
Pesticides and PCBs	10	82	± 9	85	± 8
Total Cyanides	20	92	± 8	89	± 9
Total Phenols	60	92	± 2	92	± 7
Metals	10 $\rightarrow$ 100	91	± 12	89	± 14

^a Average of all mean percentage recovery values for each compound.^b Average of all standard deviations on the mean percentage recovery for each compound.

VI. DISCUSSION OF RESULTS

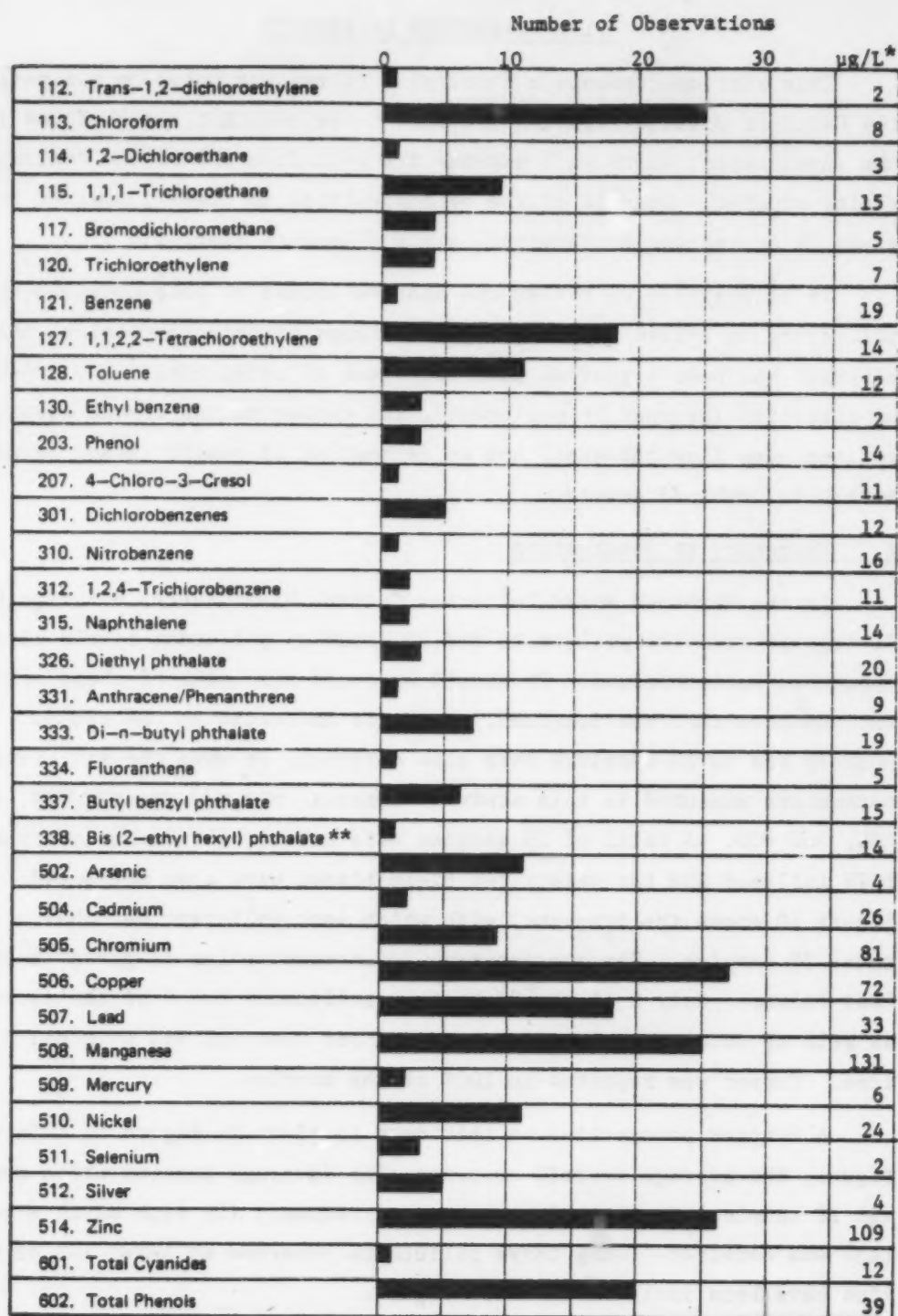
This section presents a discussion of results based on analysis of the Hartford data, by itself. Further interpretation can be found in the final report which will examine the data from all of the drainage basins studied. Details of the data presented in these summaries are given in Appendices A (Sampling) and D (Chemical Results).

It is possible to review the massive amount of data obtained during this study in myriad ways. For the purposes of this discussion, the material has been organized into four general categories: the frequency of detection (grouped by pollutant), the concentration levels observed, various mass flow analyses, and an estimation of runoff effect on metal levels in combined sewers.

A. Frequency of Observation

In the Hartford Water Pollution Control Plant (WPCP) drainage basin, 22 organic priority pollutants and 10 priority pollutant metals plus manganese were observed. It should be noted that some of these organics include more than one compound; these are indicated in the tables. Total phenols and total cyanides were also detected, as were the six classical parameters measured in this study -- ammonia, oil and grease, TSS, TOC, COD, and BOD. A total of 28 samples were collected from the sources, POTW influent and tap water; two field blanks were also collected. Figure 10 shows the frequency with which each pollutant was observed in these 28 samples. The average measured concentration is given in the last column. Only 2 of the 22 organic pollutants and 4 of the 11 metals, as well as total phenols were observed more than 50% (14 samples) of the time. Copper was reported in 100% of the samples.

A further perspective on this data is given in Figure 11. In this figure, the average overall concentration (average concentration across all 28 samples) is plotted against the frequency (%) with which a pollutant was detected. Only those pollutants observed at least 10% of the time have been included in these figures.



* Average Concentration when present

** Bis(2-ethyl hexyl)phthalate/di-n-octyl phthalate

FIGURE 10 FREQUENCY OF OBSERVATION

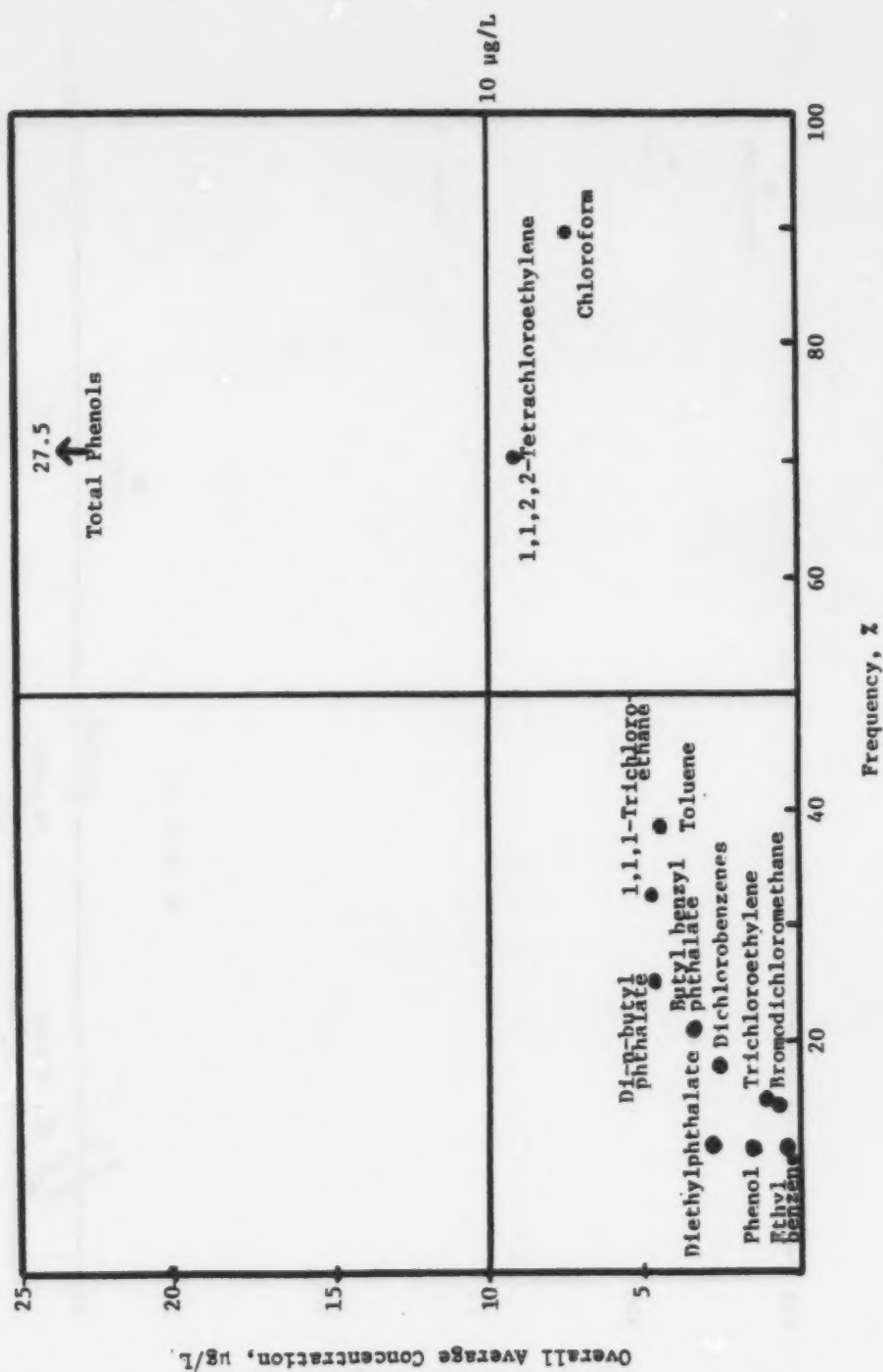


FIGURE 11 FREQUENCY OF DETECTION AND OVERALL CONCENTRATION COMPARISON

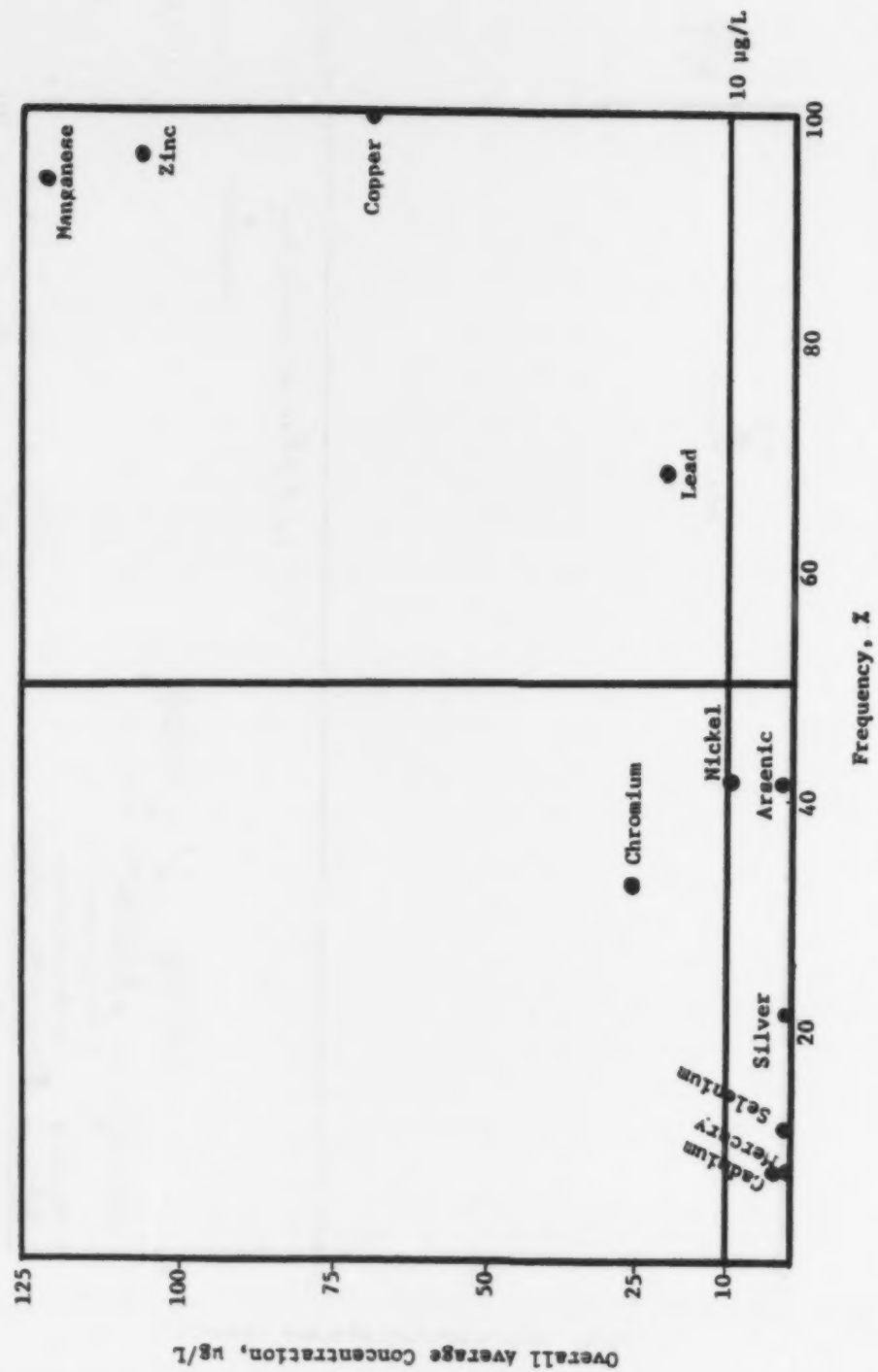


FIGURE 11 (Cont'd) FREQUENCY OF DETECTION AND OVERALL CONCENTRATION COMPARISON

Of the organics, only total phenols occur at an overall average concentration greater than 10 µg/L. Four (4) of the metals (copper, lead, manganese, and zinc) have concentrations, averaged across the basin, greater than 10 µg/L; all of these were reported in over 50% of the samples. Total cyanides appeared only once -- at the POTW influent; total phenols occurred in the majority of samples in both source and influent categories.

Four previously unreported pollutants -- 4-chloro-3-cresol, nitrobenzene, 1,2,4-trichlorobenzene and fluoranthene -- were reported in Hartford wastewater samples; all were detected at low frequency and at levels near their reporting limits.

Because of the mixed nature of the samples included in these frequency analyses, the information should be used only to determine general trends of behavior among the pollutants. A more valid interpretation of the frequency data will be carried out on a source by source basis in the multi-city analysis after a large number of sites within each source type have been studied. Some additional information can be obtained by looking at the relative mass contribution by source type, as presented later in this section.

To provide some further insight as to the frequency with which priority pollutants occur, the percent frequency of observation in the sources only and the POTW influent have been summarized in Figure 12. The solid black line represents the sources while the crosshatched line represents the POTW influent. A total of 21 source samples and 3 influent samples were analyzed. As these bar graphs are examined, the reader should bear in mind that the frequency increments are considerably different for the sources ($1/21 = 5\%$) and influent ($1/3 = 33\%$) due to the numbers of each type of sample. The variance in the frequency estimation is higher for the influent since there are fewer samples.

All of the pollutants seen in the POTW except 4-chloro-3-cresol and total cyanides, are also seen in the sources. Twelve (12) of the pollutants were seen only in the sources and not the influent. Most of the discrepancies mentioned above can be explained by the fact that the

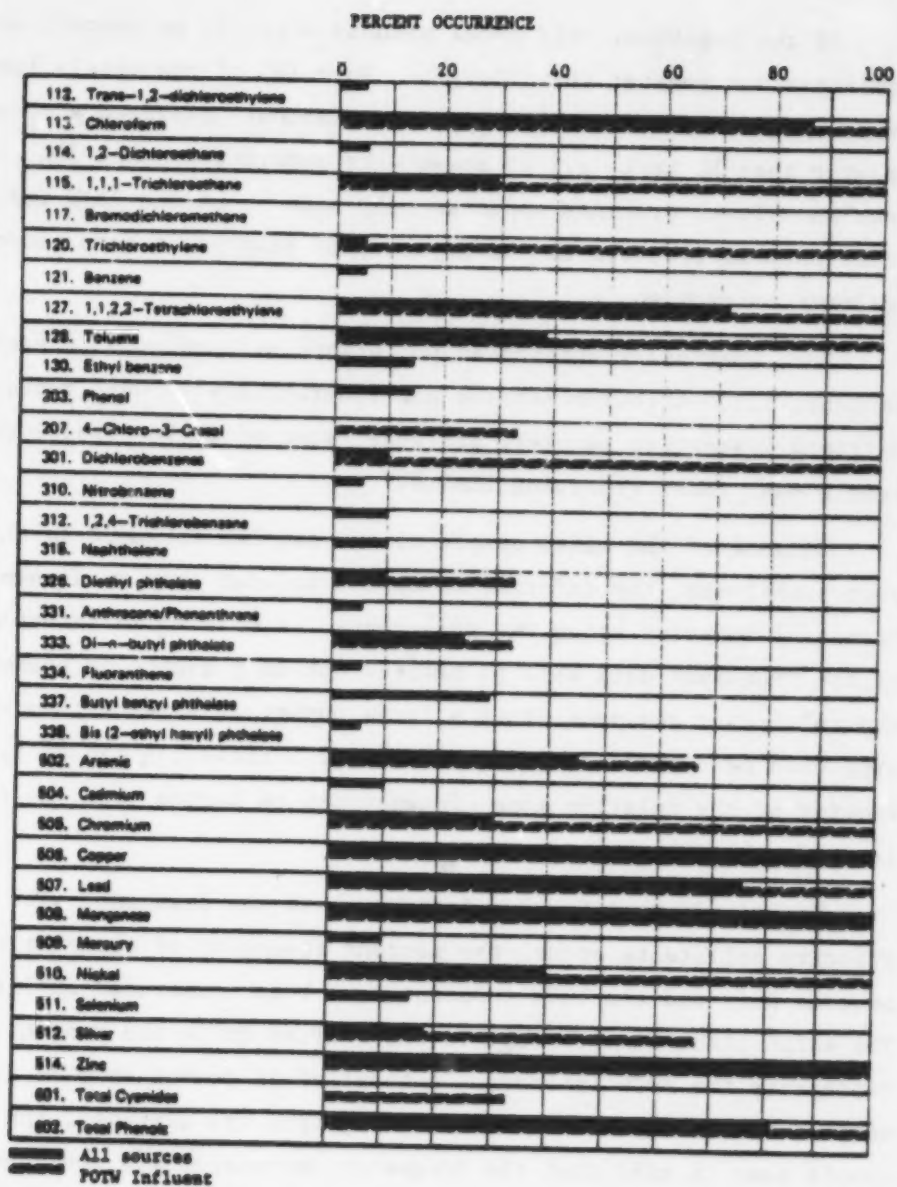


FIGURE 12 FREQUENCY OF OBSERVATIONS IN SOURCES AND INFLUENT

compounds were discovered at low frequency and at levels very close to the reporting limits.

Eight (8) metals were observed with high frequency in the influent samples; these metals were also observed often in the source samples. In addition, cadmium, mercury and selenium were reported at the sources but not measured at the POTW influent.

Table 11 gives a list of pollutants (91) which were never detected in any of the samples. Those compounds for which the analytical methods are still problematic are indicated by an asterisk. Methylene chloride was not reported for any of the samples since it appeared to be a ubiquitous contaminant.

B. Concentration of Priority Pollutants

Flow-weighted averages of the six sampling days were calculated for all of the pollutants detected; these are presented in Table 12 for the source samples and in Table 13 for the POTW influent and tap water samples. For the majority of the pollutants, there are no distinct differences between the residential and commercial sites on a concentration basis. The concentration data for the tap water are in agreement with data from previous studies; i.e., the trihalomethanes are at their highest levels in tap water, and the more common metals are also detected.

In Table 14, an average pollutant concentration (straight mean of the flow-weighted averages in Table 12) has been presented for each of the source types, along with tap water and influent, as an aid to discover the patterns that may be present in the concentration data. Only those chemicals which were observed more than three times are included in this summary. It is recognized that the concentration data by themselves do not provide the basis for estimating POTW influent values, but they are useful in observing the differences in chemical activity among the sites.

The characteristics of the Hartford area (and the Hartford WPCP basin, in particular) provided the opportunity to sample residential and commercial sources with a very limited amount of industrial activity, as well as the

Table 11

PRIORITY POLLUTANTS NEVER DETECTED IN HARTFORD

101. Chloromethane	325. 2,4-Dinitrotoluene
102. Dichlorodifluoromethane	327. 1,2-Diphenylhydrazine
103. Bromomethane	328. N-Nitrosodiphenylamine
104. Vinyl chloride	329. Hexachlorobenzene
105. Chloroethane	330. 4-Bromophenyl phenyl ether
107. Acrolein	335. Pyrene
108. Trichlorofluoromethane	336. Benzidine**
109. Acrylonitrile	340. Chrysene
110. 1,1-Dichloroethylene	341. Benzo(a)anthracene
111. 1,1-Dichloroethane	342. 3,3'-Dichlorobenzidine
116. Carbon tetrachloride	343. Benzo(b)fluoranthene
118. 1,2-Dichloropropane	344. Benzo(k)fluoranthene
119. Trans-1,3-dichloropropylene	345. Benzo(a)pyrene
122. Cis-1,3-dichloropropylene	346. Indeno(1,2,3-c,d)pyrene
123. Dibromochloromethane	347. Dibenzo(a,h)anthracene
124. 1,1,2-Trichloroethane	348. Benzo(g,h,i)perylene
125. Bromoform	349. TCDD
126. 1,1,2,2-Tetrachloroethane	401. alpha-BHC
129. Chlorobenzene	402. gamma-BHC
201. 2-Chlorophenol	403. Heptachlor
202. 2-Nitrophenol	404. beta-BHC
204. 2,4-Dimethylphenol	405. delta-BHC
205. 2,4-Dichlorophenol	406. Aldrin
206. 2,4,6-Trichlorophenol	407. Heptachlor epoxide
208. 2,4-Dinitrophenol **	408. Endosulfan I
209. 4,6-Dinitro-2-cresol **	409. DDE
210. Pentachlorophenol	410. Dieldrin
211. 4-Nitrophenol**	411. Endrin
304. Hexachloroethane	412. DDD
305. Bis(chloromethyl)ether*	413. Endosulfan II
306. Bis(2-chloroethyl) ether	414. DDT
307. Bis(2-chloroisopropyl) ether	415. Endrin aldehyde
308. N-Nitrosodimethylamine**	416. Endosulfan sulfate
309. Nitrosodi-n-propylamine	417. Chlordane
311. Hexachlorobutadiene	418. Toxaphene
313. 2-Chloroethyl vinyl ether*	419. PCB-1221
314. Bis(2-chloroethoxy)methane	420. PCB-1232
316. Isophorone	421. PCB-1242
317. Hexachlorocyclopentadiene*	422. PCB-1248
318. 2-Chloronaphthalene	423. PCB-1254
319. Acenaphthylene	424. PCB-1260
320. Acenaphthene	425. PCB-1016
321. Dimethyl phthalate	501. Antimony
322. 2,6-Dinitrotoluene	503. Beryllium
323. 4-Chlorophenyl phenyl ether	513. Thallium
324. Fluorene	

* EPA Screening Protocol procedures are inadequate for detecting these pollutants.

** Analytical problems encountered for these pollutants.

Table 12
PRIORITY POLLUTANT CHEMICAL ANALYSIS, ug/L
Flow-weighted Averages

Compound	FRANKLIN Res.	HILLSIDE Res.	TURKIS Res.	SEFTWOOD Res.	CLOVER Comm.	POTTER Comm.	SERIECA Comm.
112. Trans-1,2-dichloroethylene	-	-	-	-	-	-	1
113. Chloroform	3	5	-	3	9	4	5
114. 1,2-Dichloroethane	-	-	-	-	-	-	1
115. 1,1,1-Trichloroethane	-	1	-	24	-	7	-
117. Bromodichloromethane	-	-	-	-	-	0.3	-
120. Trichloroethylene	-	-	-	-	-	-	6
121. Benzene	-	-	-	-	-	-	6
127. 1,1,2,3-Tetrachloroethylene	4	2	0.3	1	6	25	18
128. Toluene	2	-	-	-	6	8	12
130. Ethyl benzene	-	-	-	-	1	1	1
203. Phenol	-	-	-	-	14	-	-
207. 4-Chloro-3-Cresol	-	-	-	-	-	-	-
201. Dichlorobenzene	-	-	-	-	-	7	-
310. Nitrobenzene	-	-	-	5	-	-	-
312. 1,2,4-Trichlorobenzene	3	-	-	-	-	4	-
215. Naphthalene	5	-	-	-	-	3	-
325. Diethyl phthalate	-	-	-	15	-	-	-
321. Anthracene/Phenanthrene	-	-	3	-	-	-	-
323. Di-n-butyl phthalate	-	-	15	3	17	-	-
334. Fluoranthene	-	-	-	2	-	-	-
307. Butyl benzyl phthalate	-	-	-	8	12	5	4
326. Bis (2-ethyl hexyl) phthalate	-	-	-	-	-	4	-
802. Arsenic	-	-	3	3	-	1	4
804. Cadmium	-	-	-	14	-	1	-
808. Chromium	84	13	-	-	-	84	13
806. Copper	75	41	61	67	95	93	67
807. Lead	45	5	13	29	25	59	6
809. Manganese	79	199	64	120	25	130	333
800. Mercury	-	-	-	1	-	-	3
810. Nickel	3	-	-	2	6	37	5
811. Selenium	-	1	1	-	-	-	1
812. Silver	-	-	-	-	-	NA	4
814. Zinc	100	30	54	121	218	183	77
801. Total Cyanides	-	-	-	-	-	-	-
802. Total Phenols	41	22	-	25	39	17	69

Table 12 (cont'd)

CLASSICAL WASTEWATER PARAMETER ANALYSIS, mg/L

Flow-weighted Averages

	FRANKLIN Res.	HILLSIDE Res.	TUNNIS Res.	BRENTWOOD Res.	CLOVER Comm.	POTTER Comm.	SENECA Comm.
pH	6.6	6.4	6.4	6.5	6.4	6.4	6.3
T (°C)	18.4	17	14.3	19.1	15.9	20.5	20.9
Ammonia	5	2.5	8	12	7.5	8	9
Oil and Grease	34	15	20	17	125	140	20
TSS	45	18	39	191	173	57	62
TOC	46	30	62	65	180	56	73
COD	170	112	221	300	920	277	322
BOD	60	16	75	138	351	74	101

Table 13

PRIORITY POLLUTANT CHEMICAL ANALYSIS - $\mu\text{g/L}$

Flow-weighted Averages

COMPOUND	POTW INF.	Tap	Tap	Tap
112. Trans-1,2-dichloroethylene	-	-	-	-
113. Chloroform	4	24.0	29	-
114. 1,2-Dichloroethane	-	-	-	-
116. 1,1,1-Trichloroethane	10.3	-	-	-
117. Bromodichloroethane	-	5.0	5.0	-
120. Trichloroethylene	8.4	-	-	-
121. Benzene	-	-	-	-
127. 1,1,2,2-Tetrachloroethylene	26.2	-	-	-
128. Toluene	16	-	-	-
130. Ethyl benzene	-	-	-	-
203. Phenol	-	-	-	-
207. 4-Chloro-3-Cresol	4	-	-	-
301. Dichlorobenzene	13.4	-	-	-
310. Nitrobenzene	-	-	-	-
312. 1,2,4-Trichlorobenzene	-	-	-	-
315. Naphthalene	-	-	-	-
326. Diethyl phthalate	4	-	-	-
331. A. dioxane/Phenanthrene	-	-	-	-
333. Di-n-butyl phthalate	4.2	-	8	-
334. Fluoranthene	-	-	-	-
337. Butyl benzyl phthalate	-	-	-	-
338. Bis (2-ethyl hexyl) phthalate	-	-	-	-
800. Arsenic	2	-	-	-
804. Cadmium	-	-	-	-
806. Chromium	63.4	-	-	-
808. Copper	97	93	21.0	-
807. Lead	36	-	-	-
806. Manganese	158	-	13	-
809. Mercury	-	-	-	-
810. Nickel	35.0	-	-	-
811. Selenium	-	-	-	-
812. Silver	3.3	-	-	-
814. Zinc	157	20.0	12	-
801. Total Cyanides	4.0	-	-	-
802. Total Phenols	33	-	-	-

Table 13 (cont'd)

CLASSICAL WASTEWATER PARAMETER ANALYSIS, mg/L

Flow-weighted Averages

	POTW INP		TAP 1		TAP 2
pH	6.6		6.4		6.0
T (°C)	20.7		20.5		19.4
Ammonia	9		0.5		-
Oil and Grease	37		-		-
TSS	77		-		-
TOC	43		0.5		-
COD	191		-		-
BOD	68		-		-

Table 14

AVERAGE CONCENTRATION BY SOURCE TYPE, mg/L*

<u>POLLUTANT</u>	<u>DOWNTOWN</u>	<u>RESIDENTIAL</u>	<u>COMMERCIAL</u>	<u>TAP WATER</u>	<u>INFLUENT</u>
113 CHLOROFORM	4.3	2.6	7.0	26.3	3.6
115 1,1,1-TRICHLOROETHANE	7.1	6.3	.0	2.5	10.3
117 BROMODICHLOROMETHANE	.0	.0	.0	2.5	.0
120 TRICHLOROETHYLENE	.3	.0	.0	.0	8.4
127 1,1,2,2-TETRACHLOROETHYLENE	25.0	1.6	12.2	.0	26.2
128 TOLUENE	7.5	.5	9.2	.0	15.6
301 DICHLOROBENZENES	6.6	.0	.0	.0	13.4
333 DI-N-BUTYL PHTHALATE	.0	4.4	8.6	3.8	4.2
337 BUTYL BENZYL PHTHALATE	4.6	2.1	8.0	.0	.0
502 ARSENIC	1.2	1.5	1.8	.0	1.9
505 CHROMIUM	83.5	24.3	6.6	.0	65.4
506 COPPER	93.3	61.0	81.2	56.8	96.6
507 LEAD	58.7	23.1	15.1	.0	35.6
508 MANGANESE	130.1	115.5	179.1	6.3	158.0
510 NICKEL	36.7	1.1	5.8	.0	35.0
512 SILVER	**	.0	1.7	.0	3.3
514 ZINC	183.0	81.3	147.4	15.8	157.4
602 TOTAL PHENOLS	17.3	22.0	50.8	.0	52.5
703 AMMONIA	7.6	6.8	8.3	.3	9.4
704 OIL AND GREASE	139.5	21.5	72.3	.0	37.2
705 TSS	56.9	73.0	117.6	.0	76.9
706 TOC	55.9	50.7	126.4	.3	42.5
707 COD	277.3	200.8	621.2	.0	191.0
708 BOD	74.4	72.4	225.8	.0	68.1

* Classical in mg/L.

**Not Analyzed.

chance to sample an entire downtown commercial area to be compared with the downtown area sampled in the Atlanta study.

For the purposes of Table 14, the Potter St. site has been pulled out of the commercial source category and has been tabulated as a downtown site. This site represents about 25% of the total influent flow. For most compounds, the concentration levels at the downtown site were comparable to those at the commercial and residential sites. However, there are a few compounds that exhibit substantial differences: trichloroethylene and the dichlorobenzenes were reported only at the downtown site; in addition, tetrachloroethylene, chromium, copper, lead, nickel, and zinc were reported at levels higher than the average residential or commercial concentration. Of the classicals, only oil and grease were exceptionally high at the downtown site; TSS, TOC, COD, and BOD were found at the commercial sites in very high concentrations.

As mentioned, the concentration data only provide certain clues as to possible particular sources of pollutants. They also provide a perspective on the matter of whether pollutants observed at the POTW are also observed in the sources and vice versa. The most complete analysis of this data is performed when the flow and concentration data are combined to project a total mass flow.

C. Mass Balance Analysis

1. Calculations for Scale Up

One of the objectives of this study is to predict the relative mass contribution of residential and commercial sources, in particular, to POTW influents. One reason for doing this is to be able to determine the industrial contribution at any given POTW by measurement of the influent. The total mass flow to the POTW for any pollutant may be expressed as:

$$POTW = RES + COM + IND$$

representing the total mass flow (e.g., in Kg/day) to the POTW from each of the three major source categories. Thus, for any new city, Q, if the

total contribution from the residential and commercial sources can be estimated, then the industrial contribution can be calculated after measuring the POTW as follows:

$$IND_Q = POTW_Q - (RES_Q + COM_Q)$$

One means of checking the validity of the data, as it is being developed, is to carry out a mass balance calculation for the city (x) being studied by adding the relative contributions from each source type for comparison with the POTW:

$$POTW_x = RES_x + COM_x + IND_x$$

These goals could be attained if it were possible to determine an average index value (V) for each source category which could be scaled up for each POTW basin according to the relative amount of each type of source activity in the basin (A). In the general case, the equation would take the form

$$POTW = V_R A_R + V_C A_C + V_I A_I$$

indicating the quantities of each source type (R = RES, C = COM, I = IND).

The basic data available from each sampling site to use in developing this approach is concentration, flow and population. For the POTW drainage basin as a whole, it is usually possible to obtain reliable estimates of total population (from the land planning agency) and total commercial and industrial flow (from the water use records).

For the residential sites, it is reasonable to use the population as an index basis. Thus, for the residential sites, a per capita discharge rate can be calculated as follows:

$$\text{mass/person/day} = \frac{\text{concentration} \times \text{flow}}{\text{population}}$$

For reporting convenience, the residential values have been developed in units of mg/person/day. The total basin residential contribution may

thus be estimated as:

$$\text{RES (Kg/day)} = \text{Res.Avg. (mg/person/day)} \times \text{Basin Population} \times 10^{-6}$$

For the commercial and industrial sites, the only index reliably available for all the sites studied (and the basin) is the total flow. Thus, for these source types, an average concentration value has been calculated so that, when the average value is multiplied by the total basin source type flow, the total source contribution is obtained.

$$\text{COM (Kg/day)} = [\text{Avg.Com.Conc. (ug/L)}] \times [\text{Com.Flow (Lps)}] \times 8.64 \times 10^{-5}$$

$$\text{IND (Kg/day)} = [\text{Avg.Ind.Conc. (ug/L)}] \times [\text{Ind.Flow (Lps)}] \times 8.64 \times 10^{-5}$$

The data obtained from the commercial sites do not show a very wide range in type or quantity of pollutant between sites, suggesting that an average commercial concentration is a valid concept. To the contrary, past experience shows that the industrial site data show a wide range of both type and concentration of pollutant, indicating that an average industrial concentration is not a valid concept which can be applied generally. It is useful, however, within a basin to calculate this value so that a mass balance comparison between the sources and POTW may be made. Such a comparison provides a test of how well the sites sampled represent the quantitative and qualitative nature of the whole of that source type within the basin.

Table 15 summarizes the basin characteristics of each of the sampling sites, giving the relative flow contribution from residential, commercial, and industrial source types, the estimated population, and the average measured flow. The Potter St. site is the only site with any industrial flow, and this site does seem to have a somewhat more varied pollutant load.

Table 16 shows the per capita mass discharge rates calculated for each of the residential sources and the population weighted average value. The average concentration values, calculated on a straight average basis, for the commercial sources are given in Table 17.

Table 15

SUMMARY OF SITE CHARACTERISTICS

Name	Designation	Sources		Relative Flow %			Population	Measured Flow (Lps)
		Combined	Separate	RES	COM	IND		
Franklin (including Victoria)	Residential	X		85	15	0	30,762	258.6
Hillside	Residential		X	97	3	0	2,312	31.1
Clover	Commercial		X	2	98	0	14	7.1
Potter	Commercial	X		66	29	5	70,931	602.9
Seneca	Commercial		X	46	54	0	293	3.5
Tunxis (including Maple)	Residential		X	100	0	0	1,285	13.9
Brentwood	Residential		X	100	0	0	1,527	10.6
POTW	BASIN			72	21	7	285,192	2444.0

Table 16

RESIDENTIAL SOURCES, PER CAPITA VALUES

<u>POLLUTANT</u>	<u>mg/person/day*</u>				
	<u>FRANKLIN</u>	<u>HILLSIDE</u>	<u>TUNXIS</u>	<u>BRENTWOOD</u>	<u>WEIGHTED AVERAGE</u>
113 CHLOROFORM	2.39	5.35	.00	1.60	2.46
115 1,1,1-TRICHLOROETHANE	.00	1.00	.00	14.50	.69
117 1,1-DICHLOROETHANE	.00	.00	.00	.00	.00
120 TRICHLOROETHYLENE	.00	.00	.00	.00	.00
127 1,1,2,2-TETRACHLOROETHYLENE	2.32	1.33	.32	.40	2.57
128 TOLUENE	1.37	.00	.00	.00	1.17
301 DICHLOROBENZENES	.00	.00	.00	.00	.00
333 DI-N-BUTYL PHTHALATE	.00	.00	13.56	1.91	.57
337 BUTYL BENZYL PHTHALATE	.00	.00	.00	5.00	.21
502 ARSENIC	.00	.00	2.31	2.03	.17
505 CHROMIUM	61.00	15.45	.00	.00	53.20
506 COPPER	54.31	47.84	56.91	40.21	53.39
507 LEAD	32.51	5.99	12.29	17.50	20.44
508 MANGANESE	57.33	201.68	59.69	71.97	69.27
510 NICKEL	2.01	.00	.00	1.04	1.77
512 SILVER	.00	.00	.00	.00	.00
514 ZINC	72.78	57.75	50.63	72.54	71.01
602 TOTAL PHENOLS	20.71	25.66	.00	14.95	27.76
703 AMMONIA	3.42	2.91	7.22	7.45	3.70
704 OIL AND GREASE	24.53	17.64	18.43	10.26	23.26
705 TSS	32.62	21.34	35.86	114.24	35.43
706 TOC	33.54	34.53	57.91	38.89	34.70
707 COD	123.66	130.73	206.02	179.74	129.47
708 BOD	43.59	19.02	70.02	32.79	44.62

*Classicals in g/person/day.

Table 17

COMMERCIAL AVERAGE CONCENTRATIONS, $\mu\text{g/L}^*$

<u>POLLUTANT</u>	<u>CLOVER</u>	<u>POTTER</u>	<u>SENECA</u>	<u>ARITHMETIC AVERAGE</u>
113 CHLOROFORM	9.0	4.3	5.1	6.1
115 1,1,1-TRICHLOROETHANE	.0	7.1	.0	2.4
117 BROMODICHLOROMETHANE	.0	.0	.0	.0
120 TRICHLOROETHYLENE	.0	.3	.0	.1
127 1,1,2,2-TETRACHLOROETHYLEN	6.3	25.0	18.0	16.5
128 TOLUENE	6.0	7.5	12.4	8.6
301 DICHLOROBENZENES	.0	6.6	.0	2.2
333 DI-N-BUTYL PHTHALATE	17.3	.0	.0	5.8
337 BUTYL BENZYL PHTHALATE	12.3	4.6	3.6	6.8
502 ARSENIC	.0	1.2	3.7	1.6
505 CHROMIUM	.0	83.5	13.1	32.2
506 COPPER	95.1	93.3	67.3	85.2
507 LEAD	24.7	58.7	5.6	29.6
508 MANGANESE	25.0	130.1	333.3	162.8
510 NICKEL	6.3	36.7	5.2	16.1
512 SILVER	.0	**	3.5	.8
514 ZINC	218.2	183.0	76.5	159.3
602 TOTAL PHENOLS	38.6	17.3	62.9	39.6
703 AMMONIA	7.5	7.6	9.2	8.1
704 OIL AND GREASE	125.2	139.5	19.5	94.7
705 TSS	173.1	56.9	62.1	97.4
706 TOC	179.9	55.9	73.0	102.9
707 COD	920.0	277.3	322.3	506.5
708 BOD	350.9	74.4	100.8	175.3

*Classicals in mg/L.

**Not Analyzed.

The average index values may be used to calculate, on the basis of the approach discussed above, the total mass flow from each of the source types within the Hartford WPCP basin according to the equation below:

$$\text{SUM} = \text{RES} \times \text{Population} + \text{COM} \times (\text{Flow}_C + \text{Flow}_I)$$

where RES and COM indicate the average index value either on a per capita or concentration basis, population refers to the total drainage basin population, and Flow_C and Flow_I are, respectively, the total commercial and industrial flows in the basin. In this particular basin, the industrial flow has been added to the commercial flow and scaled up on the basis of the commercial index.

The mass flow values thus calculated for the sources may be summed and compared to the mass flow at the POTW influent. This analysis has been carried out for those pollutants observed more than three times in the Hartford WPCP basin and are presented in Table 18. The data are grouped according to those pollutants whose SUM matches the POTW influent (INF), those that are higher in the influent than projected from the sum of the sources, and those that are higher in the sources than observed in the influent. For convenience, the mass values are expressed in Kg/day, except for the classicals, which are in 10^3 Kg/day.

It has been estimated that the combined uncertainty in each of the source concentration and flow measurements, as well as in the pair of influent measurements, amounts to about a factor of two. That is, in making comparisons between SUM and INF, within the error limits of the analysis, pollutants for which the SUM/INF ratios fall in the range of 0.5 - 2.0 are considered to have agreement between their projected source total (SUM) and the POTW influent (INF). The lack of pure replications precludes a formal error analysis to support this.

The usefulness of this mass balance analysis is primarily in evaluating how well the sources sampled represent the total source distribution in the basin and in providing a measure of the reliability in using the individual index values in the overall multi-city evaluation.

Table 18

MASS BALANCE ANALYSIS

		Kg/day*					
		RES	COM	SUM	INF**	SUM/INF	
Pollutants whose projected source values account for influent, 0.5 < SUM/INF < 2.0							
113	Chloroform	.67	.37	1.04	.77	1.35	
115	1,1,1-Trichloroethane	1.11	.14	1.26	2.16	.58	
333	Di-n-butyl phthalate	1.11	.35	1.46	.89	1.64	
502	Arsenic	.31	.10	.41	.41	1.00	
505	Chromium	5.46	1.97	7.44	13.81	.54	
506	Copper	14.24	5.22	19.46	20.40	.95	
507	Lead	4.88	1.81	6.69	7.51	.89	
508	Manganese	30.07	9.96	40.03	33.37	1.20	
514	Zinc	18.14	9.75	27.89	33.23	.84	
602	Total phenols	5.03	2.43	7.45	11.08	.67	
703	Ammonia	1.50	.50	2.00	1.99	1.00	
704	Oil and Grease	5.07	5.80	10.86	7.85	1.38	
705	TSS	14.59	5.96	20.55	16.23	1.27	
706	TOC	11.79	6.30	18.08	8.98	2.01	
707	COD	45.76	31.01	76.77	40.34	1.90	
708	BOD	15.40	10.73	26.13	14.37	1.82	
Pollutants whose projected source values are less than influent, SUM/INF < 0.5							
120	Trichloroethylene	.00	.01	.01	1.78	.00	
127	1,1,2,2-Tetrachloroethylene	.38	1.01	1.39	5.54	.25	
128	Toluene	.10	.53	.63	3.29	.19	
301	Dichlorobenzenes	.00	.13	.13	2.83	.05	
510	Nickel	.22	.98	1.20	7.39	.16	
512	Silver	.00	.05	.05	.69	.07	
Pollutants whose projected source values are greater than influent, SUM/INF > 2.0							
337	Butyl benzyl phthalate	.36	.42	.78	.00	(776)	

* Classicals in 10³ Kg/day

** For 2444 Lps influent flow: 1 µg/L = 0.21 Kg/day, 10 µg/L = 2.1 Kg/day

Some of the SUM/INF ratios in Table 18 are shown in parentheses () to indicate that the INF value is probably too low to allow for a meaningful comparison. A value of 0.21 Kg/day at the influent flow of 2444 Lps corresponds to a concentration of 1 µg/L; 10 µg/L equals 2.1 Kg/day.

Of the 17 pollutants for which this data analysis was carried out, 10 project a total loading which is equivalent (within the error limits) to the measured POTW influent: three organics, six metals, and total phenols. In addition, all six of the classical parameters are accounted for at the influent by the sources.

Six of the pollutants have projected source levels which are less than the influent (SUM/INF < 0.5): three chlorinated solvents, toluene, nickel and silver. The indication is that these levels are due to activities not included in the sites sampled in this survey. These chemicals were observed at significant concentrations at the downtown site, further suggesting that they may be due to industrial activity that was not measured. Only one priority pollutant, butyl benzyl phthalate, has a projected source value greater than that observed at the influent; the concentration in the influent is negligible, whereas there is a substantial contribution from both residential and commercial sources.

2. Sources of Pollutants

The relative contribution of pollutants from the different source types may be examined by calculating, from the scaled mass data presented above, the fraction contributed by each source type. For this analysis, the individual scaled RES and COM Kg/day values were divided by the SUM as shown in Table 19. The reader is cautioned that such an analysis assumes that the entire basin is as represented by the sources, an observation we know from the previous discussion to be not entirely true. It would perhaps be better to view the data in Table 19 as representative of a hypothetical drainage basin whose composition was as represented in the Hartford sites, but scaled up based upon the relative source type flows for this basin (these are Residential = 71%, Commercial = 29% [i.e., commercial = 21.5, industrial = 7.5]).

Table 19

SOURCES OF POLLUTANTS

<u>Fraction of Scaled Sum Mass</u>			
	<u>Residential</u>	<u>Commercial</u>	<u>SUM Kg/day*</u>
Residential Sources contribute more than 50% of the mass			
113 Chloroform	.64	.36	1.04
115 1,1,1-Trichloroethane	.89	.11	1.26
333 Di-n-butyl phthalate	.76	.24	1.46
502 Arsenic	.76	.24	.41
505 Chromium	.73	.27	7.44
506 Copper	.73	.27	19.46
507 Lead	.73	.27	6.69
508 Manganese	.75	.25	40.03
514 Zinc	.65	.35	27.89
602 Total phenols	.67	.33	7.45
703 Ammonia	.75	.25	2.00
705 TSS	.71	.29	20.55
706 TOC	.65	.35	18.08
707 COD	.60	.40	76.77
708 BOD	.59	.41	26.13

Commercial Sources contribute more than 50% of the mass

120 Trichloroethylene	.00	1.00	.01
127 1,1,2,2-Tetrachloroethylene	.28	.72	1.39
128 Toluene	.16	.84	.63
301 Dichlorobenzenes	.00	1.00	.13
510 Nickel	.18	.82	1.20
512 Silver	.00	1.00	.05

Pollutants with no dominant source

337 Butyl benzyl phthalate	.46	.54	.78
704 Oil and grease	.47	.53	10.86

*Classicals in 10^3 Kg/day

Of the 17 priority pollutants and 6 classical parameters presented in this table, 3 organics, 6 metals, total phenols, and 5 classicals are dominated (more than 50% of the mass) by the residential sources. Four (4) organics (including the chlorinated solvents) and two (2) metals are attributable to commercial sources. Butyl benzyl phthalate and oil and grease are contributed by both source types in almost equal quantities.

These data are in agreement with the St. Louis data where the residential sources also dominated the projected influent values, due to the small industrial component in that study.

It should be emphasized that an analysis of this type is only meaningful within the ability to obtain closure of the mass balance. As seen from Table 18, several pollutants are higher and/or lower in their projected sums than was actually observed at the influent. An analysis of this type will be more meaningful when the data from the source type in all of the cities are compared.

3. Tap Water Contribution

The potential contribution of tap water to the pollutant load at the POTW may be calculated from the measured tap water concentrations with the assumption that the tap water flow is equal to the influent flow. Such a flow estimate will be in error by the amount of inflow and infiltration in the system. Table 20 shows the calculated mass flows for the tap water, compared with values for influent and sum of the sources. This analysis shows that the tap water could be a significant source of chloroform, bromodichloromethane and copper. All other pollutants observed in the tap water constitute only a small fraction of the measured influent mass.

D. Evaluation of Runoff Effect

In addition to the increments collected for the 48-hour composited samples, aliquots were taken at the combined sewer sites during a period of rain. These samples were collected during the weekend, toward the end of the sampling period. Procedures for documenting flow, pH, and

Table 20

TAP WATER CONTRIBUTIONS, Kg/day*

<u>Pollutant</u>	<u>SUM of Sources</u>	<u>Influent</u>	<u>Tap Water</u>
113 Chloroform	1.04	.77	5.54
115 1,1,1-Trichloroethane	1.26	2.16	.53
117 Bromodichloromethane	.00	.00	.53
333 Di-n-butyl phthalate	1.46	.89	.79
506 Copper	19.46	20.40	11.98
508 Manganese	40.03	33.37	1.32
514 Zinc	27.89	33.23	3.32
703 Ammonia	2.00	1.99	.06
706 TOC	18.08	8.98	.05

* Classicals in 10^3 Kg/day

other sampling parameters were also followed for these samples. The purpose of this exercise was to evaluate the extent of the rainwater effect at sites with combined sewers, i.e., Franklin, Potter, and the POTW. One of the major difficulties in measuring the typical runoff contribution at the sites in Hartford during this period arises from the fact that the sampling interval followed a particularly wet period where there had been two recent storms, accounting for approximately three inches of rain each; the rainfall during the period in which samples were taken was measured at less than one inch.

The separated, rain event samples were prepared and analyzed for the six priority pollutant metals having significant concentration levels in the 48-hour composites. Mass flows were calculated from the concentration data and flow data. Any increase in mass flow coincident with, or slightly after, the increase in flow (due to rainfall) could be interpreted as a runoff effect. The typical observation would be a sharp increase in mass flow, followed by a gradual dilution-flush effect.

When the mass flow data for the rain samples are compared with the mass flow data for the composite samples (average concentration x average flow) for a period before and after the rain, the runoff effect can be assessed. The mass flows for these samples, collected during the weekend, would normally be expected to be lower than the weekday levels; this should be particularly evident at the Potter St. site since there is an industrial component (albeit minor) and that site is a substantial source of some of the metal pollutants.

The rain samples were analyzed for chromium, copper, lead, manganese, nickel, and zinc. Figures 13 through 15 present, by site, the average mass rates before and after the rainfall, as well as flow and precipitation data for each four-hour interval. There was no clear evidence of a runoff effect for chromium or nickel; either the mass flows were lower than those observed in the previous day, or there was no discernible peak. For the other four metals, a rainwater contribution is suggested; the rainwater effect is quite apparent for zinc and lead and slightly less apparent for manganese. The mass flows for these two metals are

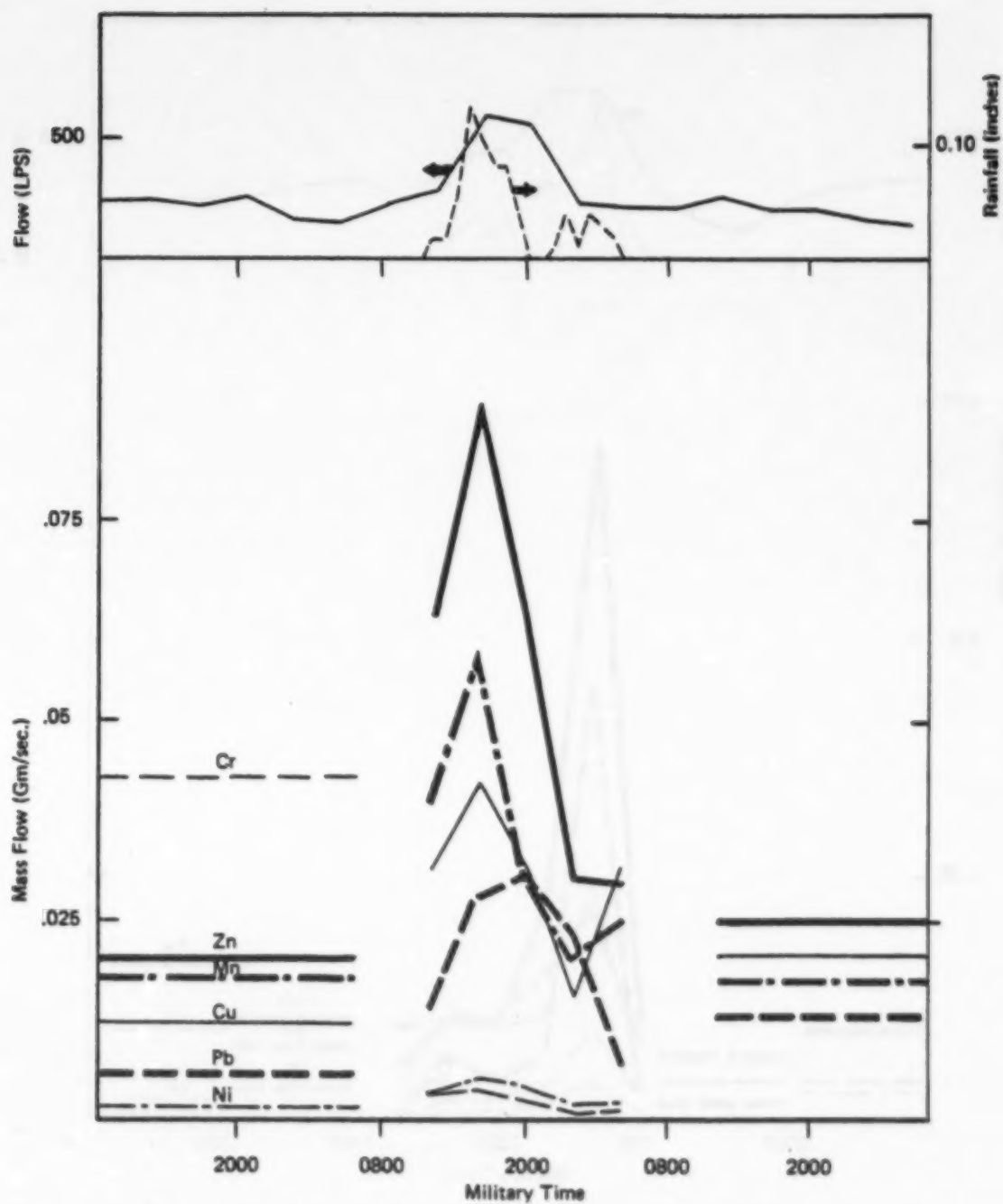


FIGURE 13 RUNOFF EFFECT—FRANKLIN AVENUE

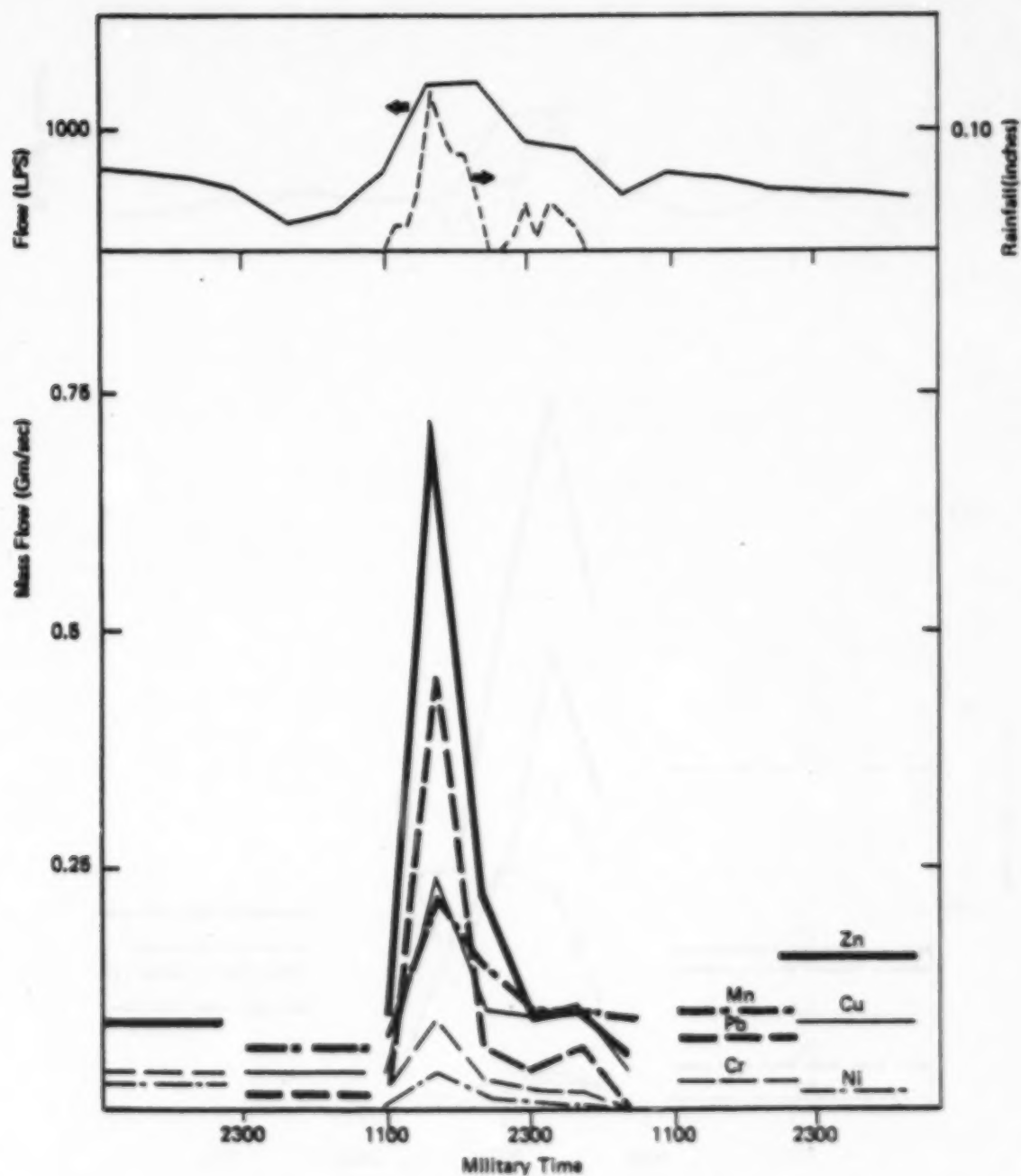


FIGURE 14 RUNOFF EFFECT—POTTER STREET

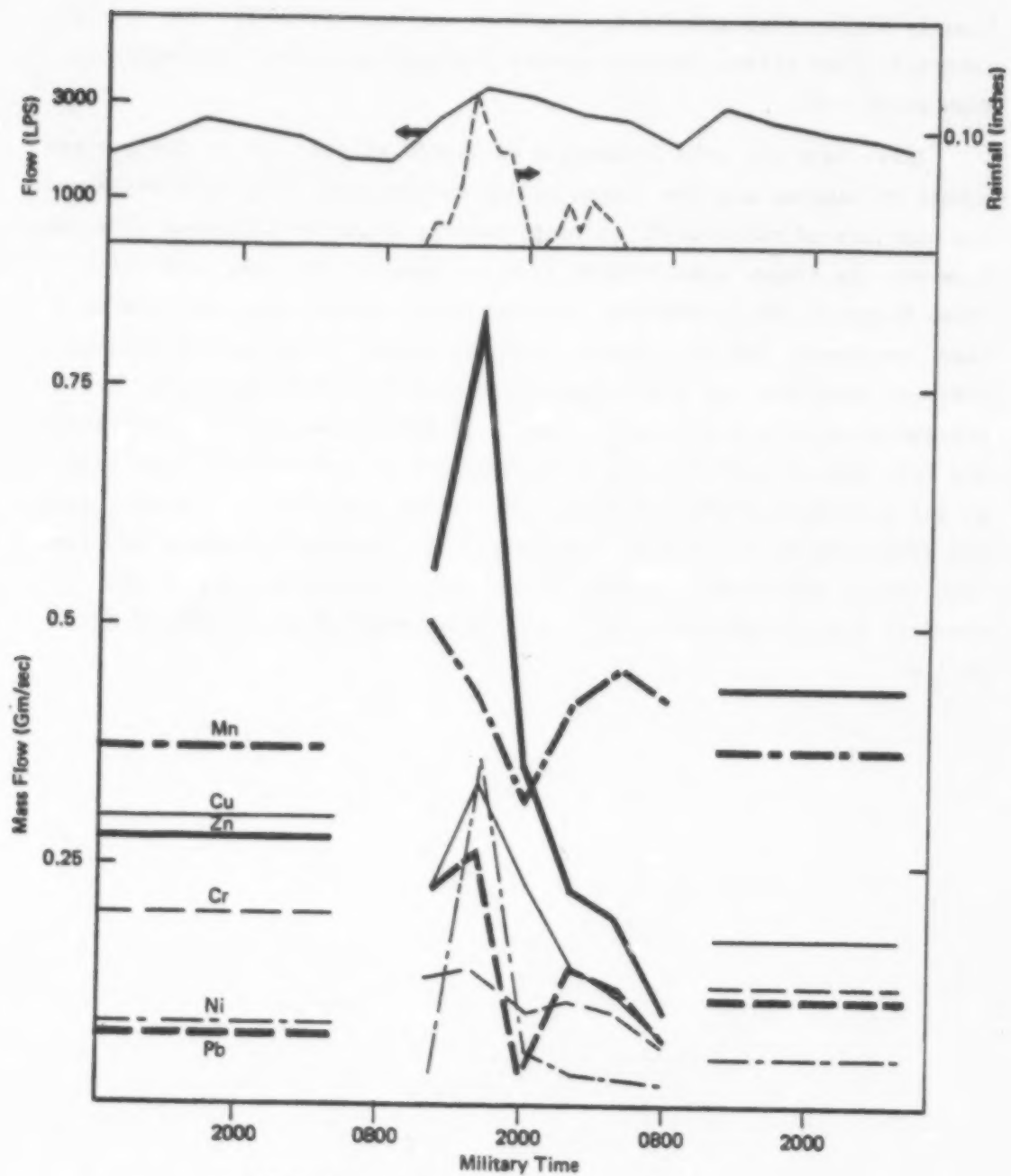


FIGURE 15 RUNOFF EFFECT—POTW INFLUENT

clearly higher than seen in the previous day's samples, and the characteristic flush effect (sharp increase followed by gradual dilution) is also exhibited.

These data are only indicative of runoff effects due to the limited number of samples and the single period during which they were collected. The question of rain/runoff warrants further study in follow-up programs. However, the trends demonstrated in these samples are consistent with those found in the literature. For instance, runoff contributions to lead, manganese, and zinc levels could be traced to automotive activity; lead and manganese are due primarily to auto emissions while zinc is attributable to tire erosion and decay of galvanized metals (guardrails). The fact that the effects are more prominent at the downtown site than at the residential site further support these conclusions. Further data are presented in Appendix F. The reader is cautioned in making any firm conclusions since the data base is extremely limited and due to the previous heavy rainstorms, the actual mass measured due to runoff may be low.

VII. CONCLUSIONS

This study of the fourth drainage basin has contributed a substantial amount of insight into the sources of toxic pollutants found at POTW influents. The survey of the Hartford Water Pollution Control Plant (WPCP) treatment area has been especially valuable in providing an increased data base with which to compare the data obtained in the previous basins. The sampling sites chosen within the Hartford basin have been primarily characterized as residential and commercial. The industrial activity in Hartford is not sufficiently confined to one particular area of the Hartford WPCP basin to have permitted sampling a separate industrial site. The Potter St. site is comparable to the Peachtree site in Atlanta in that the majority of the flow is from the downtown area including hotels, business establishments, and government buildings.

Based on the concentration and frequency data for the 28 samples collected from the source, influent, and tap, the following observations may be made:

- 35 pollutants - 22 organics, 10 metals plus manganese, total cyanides and total phenols - were observed; the six classical parameters measured in this study - ammonia, TSS, TOC, COD, BOD, and oil and grease - were also detected. There were 91 pollutants never detected in Hartford above their reporting limits.
- Only total phenols, copper, lead, manganese and zinc were present in more than 50% of the samples at an overall average concentration greater than 10 µg/L (when averaged across all the 28 samples).
- When the frequency of occurrence at the POTW influent is compared to the frequency in the source samples, it is observed that most of the pollutants seen at the influent were also measured in the sources, and vice versa. The occasional discrepancies are due to pollutants found at low frequency and near the reporting limits.

The flow-weighted concentration data and frequency data only address the question of whether or not the pollutants are to be found at the sources sampled. A more complete insight into which sources are responsible for the pollutant load at the POTW may be gained by scaling the source contributions up to represent the total basin distribution of residential, commercial, and industrial flows. This has been done in terms of Kg/day for all pollutants detected more than three times and the major conclusions are summarized below:

- Data indicate that, for 10 of the 17 commonly-observed priority pollutants, the mass flow at the influent is accounted for by the mass flow at the sources, the six classical parameters are also accounted for by the sources.
- Six of the 17 compounds (trichloroethylene, tetrachloroethylene, toluene, the dichlorobenzenes, nickel and zinc) have a projected source sum that is less than the mass flow at the influent; all these had contributions from the downtown site (where there is minor industrial flow), and all have shown in previous surveys to be due, at least in part, to industrial activities.
- Only butyl benzyl phthalate exhibited a projected sum of the sources which was greater than the mass flow at the influent.
- By comparing the scaled Kg/day values for the residential and commercial sources as fractions of the sum, the following assignments may be made: 3 organics, 6 metals, total phenols, and 5 classicals are predominantly due to residential sources; 4 organics and 2 metals are attributable to commercial activity; butyl benzyl phthalate and oil and grease have no predominant source.

Additional samples, collected at four-hour intervals from the combined sewer sites, were analyzed for chromium, copper, lead, manganese, nickel, and zinc. A rain effect, manifested as a sharp increase in mass

flow followed by a gradual decrease, was indicated for lead, zinc, and manganese. This trend is consistent with data in the literature and can be traced to automotive sources.

The chemical analysis procedures have been improved substantially for most pollutants. The quality control program continues to be invaluable in terms of daily checks on the chemical analyses and in terms of establishing the reliability of the data for subsequent calculations and projections.

The selection and isolation of sampling areas containing only one type of source activity, i.e., residential, commercial or industrial, continues to be problematic. The collection system often bears little resemblance to the surface zoning and the system maps frequently are not complete relative to direction of flow and location of manholes. A great deal of site preparation must be put into accurately locating areas whose land use is satisfactory for source type characterization.

VIII. REFERENCES

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APPENDIX A

DETAILS OF THE SAMPLING PLAN

On August 12, 1979, thirteen employees of ADL went to Hartford to obtain wastewater samples from sewers within the drainage basin serviced by the Metropolitan District Commission's Hartford WPCP. These employees were under the immediate supervision of Jeffrey Adams.

Actual sampling activities began on Tuesday, August 14, at approximately 8:00 a.m., and continued until Monday, August 21, at 8:00 a.m. Throughout this period of time, six teams of ADL employees were on duty at all hours of the day and night. Four of these teams were actively engaged in sample collection at each of the ten sampling sites that we identified, while two teams provided logistical backup and, to a limited extent, participated in the collection of samples, i.e., at the POTW.

At any given time, three teams were on duty: one stationed at the treatment plant, with the remaining two teams rotating between field sites. After twelve hours, each of the three teams were replaced by a fresh team as work continued.

The two rotating field teams were responsible for collecting samples at four-hour intervals from each of the following locations:

<u>Town/City</u>	<u>Site</u>	<u>Description</u>
Hartford	Franklin	Old residential
Hartford	Victoria	Old residential
Hartford	Hillside	Old residential
West Hartford	Clover	Commercial
Hartford	Potter	Commercial
Bloomfield	Seneca	Commercial
Bloomfield	Wintonbury Mall	Tap water
Bloomfield	Maple	New residential
Bloomfield	Tunxis	New residential
Bloomfield	Brentwood	New residential

To accomplish this, the two field teams drove through the drainage area in rented Econoline vans containing all the supplies necessary to accomplish the job. As each team finished its shift, the truck returned to the POTW for supplies and sample drop-off. From this point, the logistics crew was responsible for the logging in and packaging of all collected samples prior to their shipment to the laboratory. In addition, the logistics teams collected samples of the POTW influent and a tap water sample.

A summary of the 48-hour composite samples collected in Hartford is given in Table A-1. Sampling schedules, as well as the minimum number and size of collection bottles required by each team, have been summarized in Tables A-2 and A-3. In addition, the sampling plans utilized for QC samples, regular samples, and blanks have been outlined in Table A-4 through A-6. All samples were taken by the Manual Sampling Collection method in Table A-7 and preserved according to the requirements in Table A-8. Table A-9 is a summary of average daily measured flow values.

Table A-1

SUMMARY OF 48-HOUR COMPOSITES COLLECTED

Site and Description	DAY A			DAY B		DAY C	
	Tues.	Wed.	Thurs.	Fri.	Sat.	Sun.	
Tap Water	X	X			X	X	12 Increments
POTW Influent	X	X	X	X	X	X	12 Increments
FRANKLIN* Old Residential	X	X	X	X	X	X	12 Increments
VICTORIA* Old Residential	X	X	X	X	X	X	12 Increments
HILLSIDE Old Residential	X	X	X	X	X	X	12 Increments
CLOVER Commercial	X	X	X	X	X	X	12 Increments
POTTER Commercial	X	X	X	X	X	X	12 Increments
Field Blank			X	X			12 Increments
SENECA Commercial	X	X	X	X	X	X	12 Increments
WINTONBURY MALL Tap Water	X	X			X	X	12 Increments
MAPLE* New Residential	X	X	X	X	X	X	12 Increments
TUNXIS* New Residential	X	X	X	X	X	X	12 Increments
BRENTWOOD New Residential	X	X	X	X	X	X	12 Increments
Field Blank			X	X			12 Increments

* Sample increments from Franklin and Victoria were combined to produce a single 48-hour sample; sample increments from Maple and Tunxis were similarly combined.

Table A-2

SAMPLING SCHEDULE IN HARTFORD (Logistics)

	TUESDAY, WEDNESDAY, SATURDAY, SUNDAY				
	0800	1200	1600	2000	0400
Influent (INF)					
Tap Water (TAP)	0830	1230	1630	2030	0430
	THURSDAY, FRIDAY				
	0800	1200	1600	2000	0400
Influent (INF)					

Table A-2 (continued)
SAMPLING SCHEDULE IN HARTFORD (South)

	TEAM 1 in 0700; out 2000:					TEAM 3 in 1900; out 0800:				
	TUESDAY, WEDNESDAY, THURSDAY, FRIDAY									
Franklin (FAP)	0815	1215	1615	2015	0015	0415				
Victoria (VIC)	0900	1300	1700	2100	0100	0500				
Hillside (HSA)	0945	1345	1745	2145	0145	0545				
Clover (CLD)	1030	1430	1830	2230	0230	0630				
Potter (POT)	1115	1515	1915	2315	0315	0715				
SATURDAY, SUNDAY										
Field Blank (FB-1)	0800	1200	1600	2000	0000	0400				
Franklin (FAP)	0815	1215	1615	2015	0015	0415				
Victoria (VIC)	0900	1300	1700	2100	0100	0500				
Hillside (HSA)	0945	1345	1745	2145	0145	0545				
Clover (CLD)	1030	1430	1830	2230	0230	0630				
Potter (POT)	1115	1515	1915	2315	0315	0715				

Table A-2 (continued)

SAMPLING SCHEDULE IN HARTFORD (North)

TEAM 2 In: 0700 Out: 2000		TEAM 4 In: 1900 Out: 0800				
TUESDAY, WEDNESDAY, SATURDAY, SUNDAY						
Seneca (SEN)	0800	1200	1600	2000	0000	0400
Wintonbury Tap (WBT)	0845	1245	1645	2045	0045	0445
Tunxis (TUN)	0930	1330	1730	2130	0130	0530
Maple (MAP)	1015	1415	1815	2215	0215	0615
Brentwood (BWD)	1100	1500	1900	2300	0300	0700
THURSDAY, FRIDAY						
Seneca (SEN)	0800	1200	1600	2000	0000	0400
Field Blank (FB-2)	0845	1245	1645	2045	0045	0445
Tunxis (TUN)	0930	1330	1730	2130	0130	0530
Maple (MAP)	1015	1415	1815	2215	0215	0615
Brentwood (BWD)	1100	1500	1900	2300	0300	0700

Table A-3

MINIMUM NUMBER AND SIZE OF BOTTLES REQUIRED BY LOGISTICS AT EACH SITE

SAMPLING SITE	DAY					
	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY	SUNDAY
Influent (INF)	4 x 1L* 3 x 500mL 1 x 45mL	4 x 1L* 3 x 500mL 1 x 45mL	4 x 1L* 3 x 500mL 1 x 45mL	4 x 1L* 3 x 500mL 1 x 45mL	10 x 1L* 1 x 45mL (QC)	10 x 1L* 1 x 45mL (QC)
Tap (TAP)	1 x 1L* 1 x 500mL 4 x 250mL 1 x 45mL	1 x 1L* 1 x 500mL 4 x 250mL 1 x 45mL	not collected	not collected	1 x 1L* 1 x 500mL 4 x 250mL 1 x 45mL	1 x 1L* 1 x 500mL 4 x 250mL 1 x 45mL

* This includes the 1L bottle for Oil & Grease that only has to be collected twice each day
(one by each team)

Table A-3 (continued)
MINIMUM NUMBER AND SIZE OF BOTTLES REQUIRED BY TEAMS 1 & 3 AT EACH SITE DURING EACH VISIT

SAMPLING SITE	DAY				
	THURSDAY	FRIDAY	SATURDAY	SUNDAY	
Franklin (FAP)	4 x 1L 3 x 500ml 1 x 45ml	Same as Tuesday and Sunday			4 x 1L 3 x 500ml 1 x 45ml
Victoria (VIC)	4 x 1L 3 x 500ml 1 x 45ml	Same as Tuesday and Sunday			4 x 1L 3 x 500ml 1 x 45ml
Hillside (HLS)	4 x 1L 3 x 500ml 1 x 45ml	4 x 1L 3 x 500ml 1 x 45ml	10 x 1L 1 x 45ml (QC)	10 x 1L 1 x 45ml (QC)	10 x 1L 1 x 45ml (QC)
Cleaver (CLB)	4 x 1L 3 x 500ml 1 x 45ml	Same as Tuesday and Sunday			4 x 1L 3 x 500ml 1 x 45ml
Porter (POR)	10 x 1L 1 x 45ml (QC)	4 x 1L 3 x 500ml 1 x 45ml	4 x 1L 3 x 500ml 1 x 45ml	4 x 1L 3 x 500ml 1 x 45ml	4 x 1L 3 x 500ml 1 x 45ml
FIELD BLANK (PB-1)	not collected	not collected	not collected	not collected	not collected

*This includes the 1L bottle for Oil & Grease that only has to be collected twice each day (one by each team) and 5 x 45ml bottles are collected by Team 1 during their first field blank increment

Table A-3 (continued)
MINIMUM NUMBER AND SIZE OF BOTTLES REQUIRED BY TEAMS 2 & 4 AT EACH SITE DURING EACH VISIT

SAMPLING SITE							DAY						
							TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY	SUNDAY	
Seneca (SEN)							4 x 1L ^a 3 x 500mL 1 x 45mL	4 x 1L ^a 3 x 500mL 1 x 45mL	10 x 1L ^a 1 x 45mL (QC)	10 x 1L ^a 1 x 45mL (QC)	4 x 1L ^a 3 x 500mL 1 x 45mL	4 x 1L ^a 3 x 500mL 1 x 45mL	
Wintombury Tap (WBT)							1 x 1L ^a 1 x 500mL 4 x 250mL 1 x 45mL	1 x 1L ^a 1 x 500mL 4 x 250mL 1 x 45mL	not collected	not collected	1 x 1L ^a 1 x 500mL 4 x 250mL 1 x 45mL	1 x 1L ^a 1 x 500mL 4 x 250mL 1 x 45mL	
Tunxis (TUN)							4 x 1L ^a 3 x 500mL 1 x 45mL	← Same as Tuesday and Sunday →					4 x 1L ^a 3 x 500mL 1 x 45mL
Maple (MAP)							4 x 1L ^a 3 x 500mL 1 x 45mL	← Same as Tuesday and Sunday →					4 x 1L ^a 3 x 500mL 1 x 45mL
Brentwood (BMD)							10 x 1L ^a 1 x 45mL (QC)	10 x 1L ^a 1 x 45mL (QC)	4 x 1L ^a 3 x 500mL 1 x 45mL	4 x 1L ^a 3 x 500mL 1 x 45mL	4 x 1L ^a 3 x 500mL 1 x 45mL	4 x 1L ^a 3 x 500mL 1 x 45mL	
FIELD BLANK (FB-2)							not collected	not collected	1 x 1L ^a 1 x 500mL 4 x 250mL 5 x 45mL ^{a,b}	1 x 1L ^a 1 x 500mL 4 x 250mL 5 x 45mL ^{a,b}	not collected	not collected	

^a This includes the 1L bottles for Oil and Grease fraction that only has to be collected twice each day (one by each team)
see All 45mL bottles are collected by Team 2 during their first field blank increment

Table A-4

PLAN A-1. Each time a non-QC'd sample is withdrawn from a manhole at one of the following field sampling locations, the following number and size of bottles are to be filled:

Franklin (FAP)
 Victoria (VIC)
 Hillside (HSA) EXCEPT: Sat., Sun.
 Clover (CLD)
 Potter (POT) EXCEPT: Tues., Wed.
 Seneca (SEN) EXCEPT: Thurs., Fri.
 Tunxis (TUN)
 Maple (MAP)
 Brentwood (BWD) EXCEPT: Tues., Wed.
 Influent (INF) EXCEPT: Sat., Sun.

<u>Fraction</u>	<u>Collect</u>	<u>Code</u>
For Acid/Base Neutral and Asbestos Fraction	1 x 1L	ABN/AS
For PCB/Pesticide and BOD/TSS Fraction	1 x 1L	PCB/Class BOD
For Volatile Fraction*	1 x 45 mL. Screwcap vial does not leave any bubbles in bottles.	VOA

Note: These five fractions will be freighted to Boston daily. Be sure to pack all these freight samples separately from the other bottles.

For Metal and Mercury*	1 x 500 mL or equivalent	M+, Hg
For Cyanide Fraction*	1 x 500 mL or equivalent	CN
For Phenol Fraction*	1 x 500 mL or equivalent	Phen.
For TOC, COD and NH ₃ Fraction*	1 x 1L	NH ₃
For Oil and Grease Fraction*	1 x 1L	Class, O+G

Note: The oil and grease fraction is only to be collected twice each day at each site. I would strongly suggest that this be done during each team's first rotation between sites.

*These fractions require preservation; see attached sample preservation sheet.

Table A-5

PLAN A-2. Each time a QC'd sample is withdrawn from a manhole at one of the following field locations, the following number and size of bottles are to be filled:

POTW INF (-C only)
 Hillside (-C only)
 Potter (-A only)
 Seneca (-B only)
 Brentwood (-A only)

<u>Fraction</u>	<u>Collect</u>	<u>Code</u>
For Acid/Base Neutral, PCB/ Pesticide, Asbestos and BOD/ TSS Fraction	5 x 1L	ABN, PCB, AS, Class BOD
For Volatile Fraction*	1 x 45 mL, screw-cap vial does not leave any bubbles in bottle	VOA

Note: These five fractions are
 freighted to Boston daily.
 Be sure to segregate
 during field packaging.

For Metal and Mercury Fraction*	1 x 1L	M+, Hg
For Cyanide Fraction*	1 x 1L	CN ⁻
For Total Phenol Fraction*	1 x 1L	Phen.
For NH ₃ , TOC, and COD Fraction*	1 x 1L	NH ₃
For Oil and Grease Fraction*	1 x 1L	O+G

Note: The Oil and Grease fraction is only to be collected twice each day at each site. I would strongly recommend that this be done during each teams' first rotation between sites.

* These samples require preservation; see attached sample preservation sheet.

Table A-6

PLAN A-3. Each time a tap water or field blank sample is collected, the following number and size of bottles should be filled:

<u>Fraction</u>	<u>Collect</u>	<u>Code</u>
For Acid/Base Neutral, PCB/ Pesticide, BOD/TSS and Asbestos Fraction	1 x 500 mL or equivalent	ABN, PCB, As, Class BOD
For Volatile Fraction*	5 x 45 mL screw-cap vials during first collection sequence only on field blanks	VOA
	1 x 45 mLs on tap water	VOA

Note: These five fractions are
freighted to Boston daily.
Be sure to segregate during
field packaging.

For Metal and Mercury Fraction*	1 x 250 mL or equivalent	M, Hg
For Cyanide Fraction*	1 x 250 mL or equivalent	CN
For Total Phenol Fraction*	1 x 250 mL or equivalent	Phen.
For NH ₃ , TOC and COD Fraction*	1 x 250 mL or equivalent	NH ₃
For Oil and Grease Fraction*	1 x 1L	O+G

Note: The Oil and Grease fraction is only to be collected twice each day at each site. I would strongly recommend that this be done during each teams' first rotation between sites.

* These samples require preservation; see attached sample preservation sheet.

Table A-7

What to do During Manual Sample Collection

- 1) Gain access to the sampling location.
- 2) Set up page in field log notebook as per example. Use one per sample location and visit. Example: since Victoria is visited three times per work shift, three separate notebook pages should be used. In addition, one or two pages should be reserved for comments about each site per shift.
- 3) Fill in all preliminary data in field notebook: location, collectors (initials are sufficient), time and date.
- 4) Using the telescoping pole and bucket, obtain a wastewater sample.
- 5) While keeping the contents of the bucket well mixed, measure and record the pH and temperature of the wastewater. Also test sample with potassium iodide test paper. If test is positive (paper turns blue), indicate such in field notebook. (See Attachment C).
- 6) Attach the sample labels to the appropriate number and size of bottles. Number and size information is given in plans A-1 through A-3.
- 7) Fill in all the information required on labels.
- 8) After labeling requirements are completed, seal the label with 2" wide scotch tape.
- 9) Fill all 1L bottles to the neck with sample. Preserve appropriate bottles as below. Fill VOA bottles to overflowing (except if preservative is added as per Attachment C).
- 10) Add preservative to each bottle that requires it (see Attachment C) i.e.:

Phenols	2mL/L H_2SO_4 plus 1 gm/L $CuSO_4 \cdot 5H_2O$
Cyanides	Ascorbic acid til KI paper shows no color, plus 0.6 gm excess per liter plus 2mL/L 10N sodium hydroxide.
Metals, Mercury	3mL/L concentrated nitric acid
Total Organic Carbon COD NH ₃	2mL/L concentrated sulfuric acid
Oil and Grease	
Volatiles	

Table A-7 (Continued)

What to do During Manual Sample Collection (Continued)

- 11) Cover all bottle mouths (except VOAs) with Teflon film and seal with screw caps.
- 12) Cover all VOAs bottles with Teflon silicon septum (Teflon side towards sample). These bottles should not have any air bubbles in them!!!
- 13) Transcribe sample bottle number from label onto cap of bottle with yellow marker.
- 14) Transcribe sample bottle number and fraction identification code into field notebook.
- 15) Pack all bottles into ice chests. Segregate all Acid/Base Neutral, PCB/Pesticide and VOA fractions into one chest, i.e., all these fractions from all sites are stored in one chest. All other samples are stored in other chests as required.
- 16) Measure and record depth (cm) using dip rule and grease.
- 17) Determine linear velocity of water, at a point corresponding to 60% of measured depth, with the Marsh McBirney flow sensor. Record value obtained in field notebook.
- 18) Secure manhole and police the area for debris.
- 19) Move on to next sampling site.

Table A-8

SAMPLE PRESERVATION REQUIREMENTS

Total Phenols:	For each sample bottle collected for total phenol analysis, acidify with concentrated sulfuric acid H_2SO_4 (~ 2mL) to pH 4. Add 1 gm $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$ per liter of sample. Procedure: Check pH of raw sample with pH test paper. If needed, add 1mL conc H_2SO_4 and then check pH with test paper. Repeat until pH reaches 4. Record amount of H_2SO_4 added. Then add 1 gm/L $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$.
Cyanides:	Test each bottle collected with potassium iodide starch test paper. If color is blue, add ascorbic acid until test paper shows no color. <u>Add 0.6 gm excess of ascorbic acid to each liter bottle collected.</u> Then add 2mLs of 10 N sodium hydroxide.
Metals and Mercury:	Add 5mLs of concentrated nitric acid (HNO_3) to each liter bottle collected for metals. Check final pH with pH test paper. If pH < 2 stop, if pH > 2 add 1mL until pH < 2. Record extra amount of HNO_3 added.
Volatiles:	Check sample collected with potassium iodide (KI) starch indicator paper. Add two drops of sodium thiosulfate solution to each VOA bottle collected. If KI paper originally indicated positive (paper turns blue), check preserved sample again. If paper still positive, add two more drops sodium thiosulfate solution and recheck with KI paper. Record total number of drops of sodium thiosulfate solution used (if other than 2) to preserve sample. Seal bottle without any air bubbles.
Total Organic Carbon, Chemical Oxygen Demand, NH_3 :	Check pH of sample with pH test paper. Add concentrated sulfuric acid (H_2SO_4) until pH < 2 (~ 2mL). Record volume of H_2SO_4 added.
Oil and Grease:	Check pH of sample with pH test paper. Add concentrated sulfuric acid (H_2SO_4) until pH < 2 (~ 2mL). Record volume of H_2SO_4 added.

Table A-9

HARTFORD FLOW RATES USING DEPTH x VELOCITY

(LPS)

Location	Day A	Day B	Day C	Avg.
Franklin Victoria	260.0	228.0	287.9	258.6
Hillside	34.1	28.3	31.0	31.1
Clover	7.0*	7.1*	7.1*	7.1*
Potter	552.5	530.0	726.3	602.9
Seneca	3.1*	3.4*	3.9*	3.5
Tunxis Maple	14.4	12.0	15.2	13.9
Brentwood	10.5	9.2	12.1*	10.6
Wintonbury Tap	--	--	--	--
Tap	--	--	--	--
Influent	2418	2335	2579	2444

* Some of the nighttime velocity measurements not taken due to inability to immerse probe.
Average computed without this data.

APPENDIX B

DETAILS ON ANALYTICAL METHODS

The analytical methods for each priority pollutant category have been detailed in the Cincinnati report.³ The basic procedures used in this program were as described in the "Sampling and Analysis Procedures for Screening of Industrial Effluents for Priority Pollutants,"¹ and the "Quality Assurance Program for the Analyses of Chemical Constituents in Environmental Samples,"² U.S. EPA, Cincinnati, Ohio. Where the methods differed from those used in the Cincinnati, St. Louis and Atlanta surveys, brief descriptions follow. The sections include descriptions of problems encountered, analytical information, quality control (QC) data, and comments on the method.

Volatiles

The analytical method used for the priority pollutants in the volatile category was modified by adding charcoal to the sorbent trap and eliminating the silica gel in order to prevent the most volatile compounds from breaking through the trap. Further, the interface between the sorbent trap and gas chromatography column was improved.

An initial attempt was made during the Atlanta study to modify the volatile analytical method. Charcoal was added to the sorbent trap and four of the priority pollutants previously not detected (chloromethane, bromomethane, vinyl chloride and chloroethane) were detected during the Atlanta study. However, recovery and precision data were high, ranging from 161% $\pm$ 40 to 330% $\pm$ 126. Therefore, this procedure was investigated further during the Hartford study.

One source of difficulty was the interface between the purge and trap apparatus and the GC; this was remedied by using a longer needle through the GC septum into the cooled GC packing. In this way, the sample was injected on the GC packing more reproducibly. It was found that the shorter needle was leading to losses due to carrier gas backflushing.

Three different modified sorbent traps were studied at various purging times. For these experiments, the aqueous sample was always kept at about

49°C during purging, and the sample was always desorbed from the sorbent trap at 180°C for four minutes. The sorbent traps studied were:

1. 6 inches Tenax GC, 1 5/8 inches silica gel,
1 5/8 inches charcoal (as used in the
Atlanta study)
2. 5 1/2 inches Tenax GC, 2 inches Florisil,
1 inch charcoal
3. 5 3/4 inches Tenax GC, 2 1/8 inches charcoal

Dichlorodifluoromethane consistently broke through when the first and second sorbent traps were used, regardless of purging times (1 minute to 8 minutes). Further, the other four compounds that were being lost (chloromethane, bromomethane, vinyl chloride and chloroethane) had true recoveries (purged aqueous samples compared to directly injected calibration standards) ranging from 21% to 30%.

The third sorbent trap, consisting of only Tenax GC and charcoal, effectively trapped all the volatile priority pollutants. It was experimentally determined that a four-minute purge at 49°C and a four-minute desorb at 180°C was acceptable for recovering all the volatile priority pollutants. Acrylonitrile was recovered more efficiently with an eight-minute purge rather than four minutes (93% true recovery at eight minutes, compared to 54% at four minutes), however, chloromethane was not detected at purging times greater than four minutes due to trap breakthrough.

Table B-1 lists the true recoveries (calculated by comparing with directly injected calibration standards, rather than purged standards) for volatile priority pollutants at two-minute and four-minute purging times. Recoveries were reasonable for both times. Data for 1,1-dichloroethylene were not collected during the sorbent trap study. It was previously determined that the acrolein in the calibration standard was degraded, therefore, there are no recovery data for this compound. A four-minute purging time was used in order to ensure that acrylonitrile would be detected and to keep the total analysis time acceptable.

The relative retention times and calibration values used for volatile priority pollutant calculations are listed in Table B-2. Table B-3 presents the volatile quality control data from the Hartford study. Overall, the

Table B-1

TRUE RECOVERIES^a

Sorbent Trap: TENAX/CHARCOAL

Purging Time:		2 min.	4 min.
101.	Chloromethane	39	22
102.	Dichlorodifluoromethane	44	34
103.	Bromomethane	43	34
104.	Vinyl chloride	45	41
105.	Chloroethane	130	108
106.	Methylene chloride	253	231
107.	Acrolein ^b	-	-
108.	Trichlorofluoromethane	317	140
109.	Acrylonitrile	35	34
110.	1,1-Dichloroethylene ^c		
111.	1,1-Dichloroethane	105	90
112.	Trans-1,2-dichloroethylene	106	90
113.	Chloroform	97	83
114.	1,2-Dichloroethane	102	89
115.	1,1,1-Trichloroethane	99	74
116.	Carbon tetrachloride	97	68
117.	Bromodichloromethane	105	92
118.	1,2-Dichloropropene	19	16
119.	Trans-1,3-dichloropropylene	104	93
120.	Trichloroethylene	88	74
121.	Benzene	105	90
122.	Cis-1,3-dichloropropylene	86	73
123.	Dibromochloromethane	102	91
124.	1,1,2-Trichloroethane	96	86
125.	Bromoform	94	94
126.	1,1,2,2-Tetrachloroethane	97	103
127.	1,1,2,2-Tetrachloroethylene	96	79
128.	Toluene	96	81
129.	Chlorobenzene	97	83
130.	Ethyl benzene	96	82

^a Recoveries calculated by comparing with directly injected calibration standard.^b Acrolein standard was degraded.^c This compound was not measured.

Table 3-2
CALIBRATION VALUES FOR CONCENTRATION CALCULATIONS
Volatiles

COMPOUND	RRTs ^a	slope ^b	int. ^b	Rep. Limit	
				area	ug/L
101. Chloromethane	.153	.0021	-.0089	.0017	3
102. Dichlorodifluoromethane	.151	.0011	.0047	.0102	3
103. Bromomethane	.143	.0017	-.0038	.0047	3
104. Vinyl chloride	.153	.0023	.0002	.0117	3
105. Chloroethane	.191	.0018	-.0057	.0035	3
106. Methylene chloride	.283	.0076	.0487	.0343	1
107. Acetone	.357	.0016	.0213	.0230	1
108. Trichlorofluoromethane	.381	.0118	.0129	.0246	1
109. Acrylonitrile	.402	.0119	.1254	.1373	1
110. 1,1-Dichloroethylene	.420	.0135	.0234	.0349	1
111. 1,1-Dichloroethane	.496	.0414	.0617	.1031	1
112. Trans-1,2-dichloroethylene	.531	.0167	.0190	.0337	1
113. Chloroform	.581	.0389	.0618	.1008	1
114. 1,2-Dichloroethane	.617	.0022	.0004	.0026	1
115. 1,1,1-Trichloroethane	.679	.0217	.0329	.0546	1
116. Carbon tetrachloride	.699	.0174	.0130	.0303	1
117. Bromodichloromethane	.757	.0022	.0014	.0036	1
118. 1,2-Dichloropropane	.822	.0010	-.0006	.0004	1
119. Trans-1,3-dichloropropylene	.851	.0270	.0240	.0510	1
120. Trichloroethylene	.875	.0176	.0447	.0623	1
121. Benzene	.875	.0609	.1535	.2144	1
122. Cis-1,3-dichloropropylene	.931	.0183	.0113	.0296	1
123. Dibromodichloromethane	.933	.0168	.0224	.0392	1
124. 1,1,2-Trichloroethane	.933	.0192	.0401	.0593	1
125. Bromoform	1.109	.0175	.0043	.0218	1
126. 1,1,2,2-Tetrachloroethane	1.264	.0320	.0773	.1093	1
127. 1,1,2,2-Tetrachloroethylene	1.250	.0144	.0385	.0529	1
128. Toluene	1.300	.0432	.1288	.1721	1
129. Chlorobenzene	1.400	.0476	.1276	.1752	1
130. Ethyl benzene	1.564	.0263	.0709	.0972	1

a. Retention time, relative to 2-Bromo-1-Chloropropane

b. x = concentration

y = GC/MS relative response

Table B-3

SUMMARY OF QUALITY ASSURANCE DATA^a

Volatiles

COMPOUND	METHOD REF. STD. ^b			REPLICATE WASTEWATER SPIKE ^c					
	$\bar{P}$	Sp	%Sp	C	Rc	$\bar{P}$	Sp	%Sp	
101. Chloromethane	103	13	12	20	16	118	25	21	
102. Dichlorodifluoromethane	147	54	38	20	23	194	94	48	
103. Bromomethane	112	19	17	20	12	113	25	22	
104. Vinyl chloride	112	18	16	20	10	123	24	19	
105. Chloroethane	102	8	8	20	5	108	16	15	
106. Methylene chloride	103	10	10	20	7	127	15	12	
107. Acrolein	144	12	9	100	150	97	34	35	
108. Trichlorofluoromethane	97	8	8	20	4	105	11	11	
109. Acrylonitrile	115	12	11	100	44	119	9	8	
110. 1,1-Dichloroethylene	98	3	3	20	2	103	4	4	
111. 1,1-Dichloroethane	98	3	3	20	1	101	2	2	
112. Trans-1,2-dichloroethylene	95	0	0	20	0	102	3	3	
113. Chloroform	100	5	5	20	1	109	5	5	
114. 1,2-Dichloroethane	97	3	3	20	3	101	4	4	
115. 1,1,1-Trichloroethane	98	6	6	20	2	105	10	10	
116. Carbon tetrachloride	102	8	7	20	3	101	8	8	
117. Bromodichloromethane	97	3	3	20	2	103	5	5	
118. 1,2-Dichloropropane	103	3	3	20	1	105	3	3	
119. Trans-1,3-dichloropropylene	97	3	3	20	5	95	6	7	
120. Trichloroethylene	102	3	3	20	1	106	2	2	
121. Benzene	98	3	3	20	0	103	5	5	
122. Cis-1,3-dichloropropylene	98	6	6	20	3	99	5	5	
123. Dibromochloromethane	107	3	3	20	2	107	4	4	
124. 1,1,2-Trichloroethane	102	3	3	20	0	103	3	2	
125. Bromoform	97	6	6	20	2	93	7	7	
126. 1,1,2,2-Tetrachloroethane	102	8	8	20	1	104	4	4	
127. 1,1,2,2-Tetrachloroethylene	102	8	8	20	5	104	9	8	
128. Toluene	103	3	3	20	2	110	3	3	
129. Chlorobenzene	107	3	3	20	2	108	3	2	
130. Ethyl benzene	103	3	3	20	1	113	3	2	

^aBased on purged calibration standards.^bThree data points.^cSix data points.

quality control (QC) data determined for the samples during the Hartford study were much better than the Cincinnati, St. Louis and Atlanta QC data. This improvement can be attributed to the improved sorbent trap/gas chromatography column interface and the modified sorbent trap.

Dichlorodifluoromethane, which was previously not detected due to the fact that it was breaking through the sorbent trap, was detected in the QC samples during the Hartford study. However, another factor in the ability to detect dichlorodifluoromethane was that the analytical ion used for its measurement was changed from m/e 101 to m/e 85. The m/e 101 ion is only 13% of the MS base peak, while the m/e 85 ion is the base peak (100%). Therefore, the m/e 85 ion is the better choice for analyzing and quantifying dichlorodifluoromethane; in addition, there are no other m/e 85 fragment ion interferences in this part of the chromatogram.

The QC data for acrolein also improved during the Hartford study. It was observed during the Atlanta study that the acrolein standard was unstable, as evidenced by the lack of response when an acrolein standard was injected directly onto the GC column. Fresh standards from a different vendor were prepared for the Hartford QC samples, and the acrolein QC data improved, $96\% \pm 34$. These data indicate that sample data obtained for acrolein during the Cincinnati, St. Louis and Atlanta studies were valid; acrolein was never detected in the samples although the procedure has apparently always been valid for this compound.

Acids

The relative retention times and calibration data for the acid fraction priority pollutants are given in Table B-4, and the QC data are given in Table B-5. In general, these results are comparable to those obtained previously.

2,4-Dinitrophenol, 4,6-dinitro-2-cresol, and 4-nitrophenol chromatographed very poorly on the 1% SP 1240 DA GC column during the Hartford study. Consequently, these three compounds were not detected in the spiked QC samples. These three phenols were never detected in the samples from the three previous basins.

Table B-4

CALIBRATION VALUES FOR CONCENTRATION CALCULATIONS

ACIDS

COMPOUND	RTTs ^a	slope ^b	int. ^b	Rep. Limit	
				area	µg/L
201. 2-Chlorophenol	.321	.0669	-.1864	.4825	10
202. 2-Nitrophenol	.369	.0121	-.1558	.0257	15
203. Phenol	.449	.0690	-.0798	.6099	10
204. 2,4-Dimethylphenol	.535	.0522	-.1762	.3457	10
205. 2,4-Dichlorophenol	.555	.0541	-.2101	.3313	10
206. 2,4,6-Trichlorophenol	.703	.0411	-.1802	.2305	10
207. 4-Chloro-3-cresol	.806	.0455	.0403	.4951	10
208. 2,4-Dinitrophenol	—	.0107	-.1347	.0792	20
209. 4,6-Dinitro-2-cresol	—	.0188	-.1894	.1865	20
210. Pentachlorophenol	1.206	.0172	.0119	.1842	10
211. 4-Nitrophenol	1.996	.0116	-.1068	.0093	10

a. Retention time, relative to D₁₀-anthracene

b. x = concentration

y = GC/MS relative response

Table B-5
QUALITY CONTROL DATA
Acids

COMPOUND		Method Reference Standard ^a			Raw Wastewater Spike ^b					
		$\bar{P}$	Sp	%Sp	C	Rc	$\bar{P}$	Sp	%Sp	
201.	2-Chlorophenol	85	6	7	50	22	76	13	17	
202.	2-Nitrophenol	83	19	23	50	31	78	21	26	
203.	Phenol	67	7	10	50	29	61	14	23	
204.	2,4-Dimethylphenol	97	5	5	50	39	92	19	20	
205.	2,4-Dichlorophenol	91	6	7	50	19	91	14	15	
206.	2,4,6-Trichlorophenol	87	11	13	50	25	77	11	14	
207.	4-Chloro-3-cresol	97	9	9	50	27	85	13	16	
208.	2,4-Dinitrophenol	-			50		-			
209.	4,6-Dinitro-2-cresol	-			50		-			
210.	Pentachlorophenol	70	4	5	50	42	70	20	28	
211.	4-Nitrophenol	56	20	36	50		-			

^aBased on three data points.

^bBased on six data points.

Base/Neutrals

During the Hartford study, the 3% SP 2250 DB GC column was used in the GC/MS analysis of the base/neutral priority pollutants. Relative retention times and calibration data for the base/neutral fraction priority pollutants are given in Table B-6, and the QC data are given in Table B-7. Overall, the QC data are somewhat better than the Atlanta QC data. The improved recoveries and precision could be attributed to the simpler sample matrix (fewer interferences) in the Hartford samples.

The base/neutral priority pollutants that were not able to be detected in Hartford using the EPA protocol are listed below along with their respective problems.

- Bis(chloromethyl)ether - very short half-life in water.
- 2-Chloroethyl vinyl ether - volatile (b.p. 109°C) causing erratic recoveries during Kuderna Danish evaporation.
- Hexachlorocyclopentadiene - high GC/MS reporting limit or possible degradation in the GC injector.

The QC data for indeno(1,2,3-c,d)pyrene have been included for the Hartford study. QC data were not obtained for this compound during the other studies because the standards were not available. While the recovery was low, the precision was quite good at $29\% \pm 5$. Therefore, this compound should have been detected in samples from the other studies if it had been present in sufficient quantities. The detection limit during the Hartford study was 5 ng injected on column. Indeno(1,2,3-c,d)pyrene would have to be present in the water at a minimum concentration of 15 µg/L in order to be detected.

N-nitrosodimethylamine was successfully analyzed in the QC samples during the Hartford study; it has not been seen during the St. Louis and Atlanta studies. N-nitrosodimethylamine was added to the Hartford QC samples at a concentration level of 150 µg/L, rather than 50 µg/L used in the previous studies. It was suggested in the St. Louis³ and Atlanta⁴ reports that N-nitrosodimethylamine was not being detected due to a low recovery from water and a high GC/MS limit. This was verified by the 55% recovery and the GC/MS reporting limit of 70 µg/L, which were obtained during this study.

Table B-6

CALIBRATION VALUES FOR CONCENTRATION CALCULATIONS

Base/Neutrals

COMPOUND	RRTs ^a	slope ^b	int. ^b	Rep. Limit	
				area	ug/L
301. 1,3 Dichlorobenzene	.286	.1132	-.6135	.5188	10
302. 1,4 Dichlorobenzene					
303. 1,2 Dichlorobenzene					
304. Hexachloroethane	.323	.0539	.0488	.5879	10
305. Bis(chloromethyl)ether	-	-	-	-	-
306. Bis(2-chloroethyl) ether	.360	.0849	-.1082	.7406	10
307. Bis(2-chloroisopropyl) ether	--	.1495	1.4817	2.9767	10
308. N-Nitrosodimethylamine	.454	.0500	-3.1558	.3465	70
309. Nitrosodi-n-propylamine	.521	.0152	-.1137	.0387	10
310. Nitrobenzene	.481	.0542	-.6739	.1384	15
311. Hexachlorobutadiene	.483	.0429	-.0504	.3786	10
312. 1,2,4-Trichlorobenzene	.494	.0836	-.1679	.6683	10
313. 2-Chloroethyl vinyl ether	-	-	-	-	-
314. Bis(2-chloroethoxy) methane	.539	.0792	-.0019	.7898	10
315. Naphthalene	.521	.2393	-.8346	1.5088	10
316. Isophorone	.618	.0945	.4100	1.3545	10
317. Hexachlorocyclopentadiene	-	-	-	-	-
318. 2-Chloronaphthalene	.691	.1469	.3718	1.8406	10
319. Acenaphthylene	.757	.1759	.1975	1.9561	10
320. Acenaphthene	.775	.1440	-.0021	1.4378	10
321. Dimethyl phthalate	.807	.1600	-.1900	1.4100	10
322. 2,6-Dinitrotoluene	.818	.0340	-.0544	.2855	10
323. 4-Chlorophenyl phenyl ether	.848	.2567	.5508	3.1183	10
324. Fluorene	.848	.1733	.1233	1.8561	10
325. 2,4-Dinitrotoluene	.868	.0483	-.2288	.2542	10
326. Diethyl phthalate	.883	.1655	-.0937	1.5609	10
327. 1,2-Diphenylhydrazine	.876	.2400	.0744	2.4740	10
328. N-Nitrosodiphenylamine	.904	.0884	-.2105	.6738	10
329. Hexachlorobenzene	.915	.0499	.1076	.6061	10
330. 4-Bromophenyl phenyl ether	.920	.0461	.0771	.5381	10

Table B-6 (cont'd)

CALIBRATION VALUES FOR CONCENTRATION CALCULATIONS

Base/Neutrals

COMPOUND	RRTs ^a	slope ^b	int. ^b	Rep. Limit	
				area	ug/L
331. Anthracene	1.000	.2586	.7058	1.9990	5
332. Phenanthrene					
333. Di-n-butyl phthalate	1.091	.2979	2.5580	5.5370	10
334. Fluoranthene	1.178	.2716	.0092	1.3671	5
335. Pyrene	1.215	.3141	.2033	1.7738	5
336. Benzdine	1.289	.0189	-.0279	.1609	10
337. Butyl benzyl phthalate	1.335	.1597	-.3096	1.2875	10
338. Bis(2-ethylhexyl) phthalate	1.369	.2082	1.4242	3.5062	10
339. Di-n-octyl phthalate					
340. Chrysene	1.410	.2487	-.1204	1.1230	5
341. Benzo(a)anthracene					
342. 3,3'-Dichlorobenzidine	1.454	.0633	-.5560	.0774	10
343. Benzo(b)fluoranthene	1.582	.3093	-.1208	.1885	1
344. Benzo(k)fluoranthene					
345. Benzo(a)pyrene	1.659	.2614	-.5017	.8054	5
346. Indeno (1,2,3-c,d) pyrene	2.050	.1738	.3143	1.1831	5
347. Dibenzo (a,h) Anthracene	2.060	.1604	-.7805	.0213	5
348. Benzo (g,h,i) perylene	2.193	.1774	.4209	1.3078	5

a. Retention time, relative to D₁₀-anthracene

b. x = concentration

y = GC/MS relative response

Table B-7

QUALITY CONTROL DATA

Base/Neutrals

COMPOUND		Method Reference Standard ^a			Raw Wastewater Spike ^b				
		F	Sp	XSp	C	Rc	F	Sp	XSp
301.	1,3 Dichlorobenzene	72	5	7	153	12	74	8	11
302.	1,4 Dichlorobenzene								
303.	1,2 Dichlorobenzene								
304.	Hexachloroethane	57	7	12	50	24	63	16	26
305.	Bis(chloromethyl)ether								
306.	Bis(2-chloroethyl) ether	84	7	9	50	5	81	8	10
307.	Bis(2-chloroisopropyl) ether				c				
308.	N-Nitrosodimethylamine	50	4	8	150	60	37	29	73
309.	Nitrosodi-n-propylamine	97	5	5	50	7	109	9	9
310.	Nitrobenzene	77	3	4	50	23	72	7	10
311.	Hexachlorobutadiene	74	7	9	50	22	67	9	13
312.	1,2,4-Trichlorobenzene	80	2	3	50	4	75	12	16
313.	2-Chloroethyl vinyl ether								
314.	Bis(2-chloroethoxy) methane	95	12	13	50	9	102	11	10
315.	Naphthalene	85	6	7	50	9	84	12	14
316.	Isophorone	110	11	10	50	6	113	9	8
317.	Hexachlorocyclopentadiene								
318.	2-Chloronaphthalene	73	6	9	50	17	72	11	15
319.	Acenaphthylene	79	6	8	50	14	78	9	12
320.	Acenaphthene	75	8	10	50	25	70	12	17
321.	Dimethyl phthalate	41	8	20	50	17	58	5	9
322.	2,6-Dinitrotoluene	84	9	10	50	11	70	15	22
323.	4-Chlorophenyl phenyl ether	83	8	10	50	23	71	13	18
324.	Fluorene	77	10	13	50	24	68	17	24
325.	2,4-Dinitrotoluene	92	7	8	50	15	43	10	23
326.	Diethyl phthalate	70	12	17	50	12	85	16	19
327.	1,2-Diphenylhydrazine	79	17	22	50	17	69	19	27
328.	N-Nitrosodiphenylamine	87	10	11	50	10	88	12	13
329.	Hexachlorobenzene	75	10	14	50	33	58	13	22
330.	4-Bromophenyl phenyl ether	93	8	8	50	40	73	14	20

Table B-7 (cont'd)

QUALITY CONTROL DATA

Base/Neutrals

COMPOUND		Method Reference Standard ^a			Raw Wastewater Spike ^b					
		F	Sp	%Sp	C		Rc	F		Sp
331.	Anthracene	81	9	11	100	63	71	16	23	
332.	Phenanthrene									
333.	Di-n-butyl phthalate	94	24	25	50	51	84	23	28	
334.	Fluoranthene	83	8	10	50	42	63	15	24	
335.	Pyrene	83	10	12	50	50	61	14	23	
336.	Benzidine	116	68	58	150	347	17	16	95	
337.	Butyl benzyl phthalate	55	15	27	50	40	49	27	55	
338.	Bis(2-ethylhexyl) phthalate	60	25	41	100	60	47	16	34	
339.	Di-n-octyl phthalate									
340.	Chrysene	68	14	21	100	66	54	9	17	
341.	Benzo(a)anthracene									
342.	3,3'-Dichlorobenzidine	84	10	12	50	15	67	18	27	
343.	Benzo(b)fluoranthene	59	13	22	9	5	44	7	16	
344.	Benzo(k)fluoranthene									
345.	Benzo(a)pyrene	57	8	15	50	43	42	8	18	
346.	Indeno (1,2,3-c,d) pyrene	43	8	19	50	38	29	5	19	
347.	Dibenzo (a,h) Anthracene	65	10	16	41	50	50	9	17	
348.	Benzo (g,h,i) perylene	49	8	17	50	48	34	7	20	

^a Based on three data points.^b Based on six data points.^c Standard not available to spike into QC sample.

The benzidine QC data were still poor. This compound is problematic due to heat lability, instability in CH_2Cl_2 and poor chromatography. The QC data for benzo(g,h,i)perylene were improved as compared to the data from Atlanta. Overall, the GC/MS sensitivity for the polynuclear aromatic hydrocarbon priority pollutants improved. This was due in part to improved chromatography on the 3% SP 2250 DB GC column.

Pesticides and PCBs

Typical calibration values used to calculate pesticide and PCB concentration levels are given in Table B-8, and the QC data are given in Table B-9. Overall, the Hartford quality control data were substantially better than that from the previous cities.

QC data for endrin aldehyde and endosulfan sulfate have been included for the Hartford study. QC data were not obtained for these two compounds during the other studies because the standards were not available. The recovery and precision data are good and provide a basis for concluding that the data obtained on these two compounds during the other studies were valid; specifically, endrin aldehyde and endosulfan sulfate were never observed in the samples but would have been observed if they were present since the procedures are valid.

Total Cyanides and Total Phenols

The QC data for total cyanides and total phenols are given in Table B-10. These data are comparable to those obtained previously.

Metals

A newly acquired Instrumentation Laboratories Model 551 Atomic Absorption Spectrophotometer was used for all atomic absorption analyses including flame atomic absorption analyses of certain elements for which plasma emission spectroscopy had been used for samples from St. Louis and Atlanta. The precision obtained with the Model 551 was in all cases comparable or superior to that obtained with the atomic absorption and plasma emission spectroscopic instrumentation used for St. Louis and Atlanta samples. The techniques used and the reporting limits for the metal priority pollutants are listed in Table B-11.

Table B-8

CALIBRATION VALUES FOR CONCENTRATION CALCULATIONS

Pesticides

COMPOUND	Slope	Intercept	Reporting Limit (ug/L)
401. alpha-BHC	6.899	0.0142	1
402. gamma-BHC	6.521	0.0100	1
403. Heptachlor	6.6164	0.0167	1
404. beta-BHC	2.8095	.0243	1
405. delta-BHC	5.7378	.0069	1
406. Aldrin	6.7108	.0046	1
407. Heptachlor epoxide	6.1146	.0199	1
408. Endosulfan I.	7.4834	.0324	1
409. DDE	7.8487	.0348	1
410. Dieldrin	10.1393	.0464	1
411. Endrin	4.2436	.0105	1
412. DDD	5.1678	.0058	1
413. Endosulfan II			
414. DDT	3.5515	.0224	1
415. Endrin aldehyde	5.2609	.0514	1
416. Endosulfan sulfate	3.7071	.0734	1
417. Chlordane			
418. Toxaphene			
419. PCB-1221			
420. PCB-1232			
421. PCB-1242			
422. PCB-1248			
423. PCB-1254	.8851	.0172	1
424. PCB-1260			
425. PCB-1016			

Table B-9

QUALITY CONTROL DATA

Pesticides

COMPOUND	Method Reference Standard (a)				Raw Wastewater (b)			
	F	Sp	ISp	C	Rc	F	Sp	ISp
401. alpha-BHC	82	4	5	10	3	84	7	8
402. gamma-BHC	79	4	5	12	2	83	6	7
403. Heptachlor	80	4	5	11	2	82	6	7
404. beta-BHC	86	5	6	9	2	92	5	5
405. delta-BHC	94	6	6	9	2	110	8	7
406. Aldrin	82	7	8	11	1	85	4	5
407. Heptachlor epoxide	84	8	10	11	2	84	4	5
408. Endosulfan I.	85	11	13	10	4	90	10	11
409. DDE	95	11	12	10	2	95	5	5
410. Dieldrin	45	9	20	10	2	49	3	6
411. Endrin	73	17	24	11	2	96	9	9
412. DDD	86	5	6	20	6	89	9	10
413. Endosulfan II								
414. DDT	97	16	17	9	2	92	7	8
415. Endrin aldehyde	85	17	20	5	3	60	17	29
416. Endosulfan sulfate	85	17	20	16	4	84	15	18
417. Chlordane (c)								
418. Toxaphene (c)								
419. PCB-1221 (c)								
420. PCB-1232 (c)								
421. PCB-1242 (c)								
422. PCB-1248 (c)								
423. PCB-1254	78	5	6	90	15	81	6	7
424. PCB-1260 (c)								
425. PCB-1016 (c)								

^a Calculated from 3 data points.

^b Calculated from 6 data points.

^c Not added into QC samples (A,B,D).

Table B-10

QUALITY CONTROL DATA

Total Cyanides/Total Phenols

	Method Reference Standard (a)			Raw Wastewater Spikes (b)				
	F	Sp	15p	C	Rc	F	Sp	15p
Total Cyanides	92	8	9	20	1	89	9	10
Total Phenols	92	2	3	60	1	92	7	8

^a Based on 3 data points.

^b Based on 6 data points.

Table B-11

Analytical Method and Reporting Limits

METALS

	Method of Instrumental Analysis	Reporting Limit, ug/L
501. Antimony	Flameless AAS	1
502. Arsenic	AA-Hydride Evolution	2
503. Beryllium	Flameless AAS	1
504. Cadmium	Flameless AAS	1
505. Chromium	FES	16
506. Copper	Flame AAS	4
507. Lead	Flame AAS	5
508. Manganese	Flame AAS	8
509. Mercury	Flameless AAS Cold Vapor	1
510. Nickel	Flameless AAS	4
511. Selenium	AA-Hydride Evolution	1
512. Silver	Flameless AAS	1
513. Thallium	Flameless AAS	1
514. Zinc	Flame AAS	6

The metals QC data are given in Table B-12. Overall, the data are comparable to the QC data from St. Louis and Atlanta. The recovery values obtained for selenium ($28\% \pm 8$) from raw wastewater were low.

Field Blanks

Two field blank samples were collected and analyzed for all the priority pollutants in order to determine the extent of possible contamination. The concentration data for these samples are presented in Table B-13.

Sample	As	Cd	Cr	Pb	Mn	Se	Ag	Al	Ar	B	Br	Cu	Fe	Hg	I	K	Li	Mg	Mo	Ni	S	Ti	V	Zn
Blank 1																								
Blank 2																								

Table B-12
QUALITY CONTROL DATA ^a

Metals

COMPOUND		Method Reference Standard			Raw Wastewater Spike					
		F	Sp	%Sp	C	Rc	F	Sp	%Sp	
501.	Antimony	62	29	46	10	5	40	15	37	
502.	Arsenic b	88	3	4	25	2	98	11	12	
503.	Beryllium	88	5	5	10	0	94	5	6	
504.	Cadmium	80	45	57	10	6	103	16	15	
505.	Chromium	128	15	12	100	0	101	48	48	
506.	Copper	98	17	17	50	9	97	11	12	
507.	Lead	94	6	6	50	30	93	15	16	
508.	Manganese b	94	4	5	100	16	100	9	9	
509.	Mercury	92	5	5	10	4	81	15	19	
510.	Nickel	109	7	7	50	13	110	12	11	
511.	Selenium	62	26	42	10	0	28	8	28	
512.	Silver b	92	5	5	10	1	91	14	15	
513.	Thallium	94	6	6	10	2	105	5	5	
514.	Zinc b	96	3	4	100	20	102	5	5	

^a Based on five quality control sets.

^b Based on four quality control sets.

Table B-13
PRIORITY POLLUTANTS, ug/L

SAMPLE NUMBER	FIELD BLANKS						Avg.
	419		420				
112. Trans-1,2-dichloroethylene	-		-				-
113. Chloroform	-		-				-
114. 1,2-Dichloroethane	-		-				-
115. 1,1,1-Trichloroethane	-		-				-
117. Bromodichloromethane	-		-				-
120. Trichloroethylene	-		-				-
121. Benzene	-		-				-
127. 1,1,2,2-Tetrachloroethylene	-		-				-
128. Toluene	-		-				-
130. Ethyl benzene	-		-				-
203. Phenol	-		-				-
207. 4-Chloro-3-Cresol	-		-				-
301. Dichlorobenzene	-		-				-
310. Nitrobenzene	-		-				-
312. 1,2,4-Trichlorobenzene	-		-				-
315. Naphthalene	-		-				-
326. Diethyl phthalate	-		-				-
331. Anthracene/Phenanthrene	-		-				-
333. Di-n-butyl phthalate	-		-				-
334. Fluoranthene	-		-				-
337. Butyl benzyl phthalate	-		-				-
338. Bis (2-ethyl hexyl) phthalate	-		-				-
502. Arsenic	-		-				-
504. Cadmium	-		-				-
505. Chromium	-		-				-
506. Copper	25		-				8.3
507. Lead	-		-				-
508. Manganese	-		-				-
509. Mercury	-		-				-
510. Nickel	-		-				-
511. Selenium	-		-				-
512. Silver	-		-				-
514. Zinc	23		-				7.7
601. Total Cyanides	-		-				-
602. Total Phenols	-		-				-

Table B-13 (cont'd)

CLASSICAL PARAMETERS, mg/L

FIELD BLANKS

SAMPLE NUMBER	419			420			Avg.
pH	-			-			-
T (°C)	-			-			-
Ammonia	.05			-			-
Oil and Grease	-			-			-
TSS	-			-			-
TOC	-			-			-
COD	-			-			-
BOD	-			-			-

APPENDIX C

ACID AND BASE/NEUTRAL AQUEOUS INTERNAL STANDARDS

The procedure used to add internal standards to the Hartford samples has been detailed in the Atlanta report.⁵ D₁₀-anthracene was added to the final concentrated methylene chloride extract and four "total method" internal standards were added to the aqueous sample (prior to extraction and concentration) for acid and base/neutral analyses.

For the acid analysis, only three of the four total method internal standards were analyzed. The fourth internal standard, 9-phenylanthracene, did not elute from the acid GC column within a reasonable period of time. The percentage recoveries for the other three total method internal standards (relative to d₁₀-anthracene) were:

from raw wastewater (A, B, C) --

2-Fluoronaphthalene	77% $\pm$ 15
Octafluorobiphenyl	68% $\pm$ 14
Decafluorobiphenyl	55% $\pm$ 20
n = 37	

and from clean water (D, F) --

2-Fluoronaphthalene	70% $\pm$ 8
Octafluorobiphenyl	65% $\pm$ 8
Decafluorobiphenyl	55% $\pm$ 20
n = 8	

Overall, the Hartford "total method" internal standard QC data for acids were comparable to the data from Atlanta, with improvement in the precision.

The percentage recoveries for these internal standards in the base/neutral analysis (relative to d₁₀-anthracene) were:

from raw wastewater (A, B, C) --

2-Fluoronaphthalene	101% ± 9
Octafluorobiphenyl	88% ± 13
Decafluorobiphenyl	75% ± 15
9-Phenylanthracene	80% ± 8

n = 36

and from clean water (D, F) --

2-Fluoronaphthalene	101% ± 7
Octafluorobiphenyl	88% ± 16
Decafluorobiphenyl	75% ± 12
9-Phenylanthracene	101% ± 0.1

n = 7

Again, the Hartford "total method" internal standard QC data for base/neutrals were better than the data from Atlanta. This improvement probably reflects the less complex Hartford sample matrix. These data indicate that the total method, as used in Hartford, was in control for all samples analyzed.

APPENDIX D

ANALYTICAL DATA BY SITE

This appendix contains the results of the chemical analyses for all the samples obtained in Hartford. The data have been organized by site. Each sample represents a 48-hour collection period; the increments were flow composited to produce the final sample. In addition, the average presented for each chemical is a flow-weighted average of the individual samples collected at each location.

The data for the organics, metals, total cyanides, and total phenols (100-300, 500, and 600 series) are given in $\mu\text{g/L}$; the data on the classical parameters (700 series) are presented in mg/L . Only those compounds detected at least once in the Hartford samples have been included in these tables.

HARTFORD SAMPLES

Sampling Sites	Abbr.	Tues 8/14	Wed 8/15	Thurs Fri 8/16 8/17	Sat 8/18	Sun 8/19	
Influent	INF	401		411	421-QC		Influent
Tap	TAP	402		-	422		Tap
Franklin	FAP	403		412	423		Old Residential, Combined Sewers
Victoria	VIC						Old Residential, Sanitary Sewers
Hillside	HSA	404		413	424-QC		Commercial
Clover	CLD	405		414	425		Downtown, Combined Sewers
Potter	POT	406-QC		415	426		Commercial, Sanitary Sewers
Seneca	SEN	407		416-QC	427		Tap
Wintonbury Tap	WBT	408		-	428		New Residential, Sanitary Sewers with PVC pipe
Tunxis	TUN	409		417	429		New Residential, Sanitary Sewers, Asbestos-cement pipe
Maple	MAP						Field Blank
Brentwood	BMD	410-QC		418	430		Field Blank
Field Blank 13	FB13			419			
Field Blank 24	FB24			420			
Total Lab Samples		18		14	18	50	
QC-Contingency Samples		4			4		
Lab Samples less Contingency Samples		14		14	14	42	

PRIORITY POLLUTANT CHEMICAL ANALYSIS

POTW INFLUENT

SAMPLE NUMBER	401	411	421	Avg.
112. Trans-1,2-dichloroethylene	-	-	-	-
113. Chloroform	4	4	3	3.6
114. 1,2-Dichloroethane	-	-	-	-
115. 1,1,1-Trichloroethane	10	13	8	10.3
117. Bromodichloromethane	-	-	-	-
120. Trichloroethylene	8	16	2	8.4
121. Benzene	-	-	-	-
127. 1,1,2,2-Tetrachloroethylene	42	30	8	26.2
128. Toluene	7	34	7	15.6
130. Ethyl benzene	-	-	-	-
203. Phenol	-	-	-	-
207. 4-Chloro-3-Cresol	11	-	-	3.7
301. Dichlorobenzenes	15	10	15	13.4
310. Nitrobenzene	-	-	-	-
312. 1,2,4-Trichlorobenzene	-	-	-	-
315. Naphthalene	-	-	-	-
326. Diethyl phthalate	11	-	-	3.6
331. Anthracene/Phenanthrene	-	-	-	-
333. Di-n-butyl phthalate	-	-	12	4.2
334. Fluoranthene	-	-	-	-
337. Butyl benzyl phthalate	-	-	-	-
338. Bis (2-ethyl hexyl) phthalate	-	-	-	-
502. Arsenic	3	3	-	1.9
504. Cadmium	-	-	-	-
505. Chromium	64	86	48	65.4
506. Copper	96	130	67	96.6
507. Lead	30	32	44	35.6
508. Manganese	170	160	145	158
509. Mercury	-	-	-	-
510. Nickel	52	35	19	35.0
511. Selenium	-	-	-	-
512. Silver	7	3	-	3.3
514. Zinc	180	120	170	157
601. Total Cyanides	12	-	-	4.0
602. Total Phenols	52	49	56	52.5

CLASSICAL PARAMETERS ANALYSIS

POTW INFLUENT

SAMPLE NUMBER	401		411		421			Avg.
pH	6.5		6.8		6.6			6.6
T (°C)	20.8		20.7		20.5			20.7
Ammonia	9.0		11		8.4			9.4
Oil and Grease	50		65		-			37
TSS	85		65		80			77
TOC	50		32		45			43
COD	280		100		190			191
BOD	70		75		60			68

PRIORITY POLLUTANT CHEMICAL ANALYSIS

TAP 1							
SAMPLE NUMBER	402	422					Avg.
112. Trans-1,2-dichloroethylene	-	-					-
113. Chloroform	24	24					24.0
114. 1,2-Dichloroethane	-	-					-
115. 1,1,1-Trichloroethane	-	-					-
117. Bromodichloromethane	7	3					5.0
120. Trichloroethylene	-	-					-
121. Benzene	-	-					-
127. 1,1,2,2-Tetrachloroethylene	-	-					-
128. Toluene	-	-					-
130. Ethyl benzene	-	-					-
203. Phenol	-	-					-
207. 4-Chloro-3-Cresol	-	-					-
301. Dichlorobenzenes	-	-					-
310. Nitrobenzene	-	-					-
312. 1,2,4-Trichlorobenzene	-	-					-
315. Naphthalene	-	-					-
326. Diethyl phthalate	-	-					-
331. Anthracene/Phenanthrene	-	-					-
333. Di-n-butyl phthalate	-	-					-
334. Fluoranthene	-	-					-
337. Butyl benzyl phthalate	-	-					-
338. Bis (2-ethyl hexyl) phthalate	-	-					-
502. Arsenic	-	-					-
504. Cadmium	-	-					-
505. Chromium	-	-					-
506. Copper	75	110					92.5
507. Lead	-	-					-
508. Manganese	-	-					-
509. Mercury	-	-					-
510. Nickel	-	-					-
511. Selenium	-	-					-
512. Silver	-	-					-
514. Zinc	11	29					20.0
601. Total Cyanides	-	-					-
602. Total Phenols	-	-					-

CLASSICAL PARAMETERS ANALYSIS

TAP 1

SAMPLE NUMBER	402				422			Avg.
pH	6.3				6.6			6.4
T (°C)	20.8				20.2			20.5
Ammonia	1.0				.05			0.5
Oil and Grease	-				-			-
TSS	-				-			-
TOC	-				1			0.5
COD	-				-			-
BOD	-				-			-

PRIORITY POLLUTANT CHEMICAL ANALYSIS

FRANKLIN

SAMPLE NUMBER	403	412	423	Avg.
112. Trans-1,2-dichloroethylene	-	-	-	-
113. Chloroform	3	4	3	3.3
114. 1,2-Dichloroethane	-	-	-	-
116. 1,1,1-Trichloroethane	-	-	-	-
117. Bromodichloromethane	-	-	-	-
120. Trichloroethylene	-	-	-	-
121. Benzene	-	-	-	-
127. 1,1,2,2-Tetrachloroethylene	5	5	2	3.9
128. Toluene	3	3	-	1.9
130. Ethyl benzene	-	-	-	-
203. Phenol	-	-	-	-
207. 4-Chloro-3-Cresol	-	-	-	-
301. Dichlorobenzenes	-	-	-	-
310. Nitrobenzene	-	-	-	-
312. 1,2,4-Trichlorobenzene	-	10	-	3.3
315. Naphthalene	-	18	-	3.3
326. Diethyl phthalate	-	-	-	-
331. Anthracene/Phenanthrene	-	-	-	-
333. Di-n-butyl phthalate	-	-	-	-
334. Fluoranthene	-	-	-	-
337. Butyl benzyl phthalate	-	-	-	-
338. Bis (2-ethyl hexyl) phthalate	-	-	-	-
502. Arsenic	-	-	-	-
504. Cadmium	-	-	-	-
505. Chromium	1	190	-	84.0
506. Copper	100	54	91	74.8
507. Lead	100	29	57	44.8
508. Manganese	3	80	78	78.9
509. Mercury	100	-	-	-
510. Nickel	100	6	-	2.8
511. Selenium	1	-	-	-
512. Silver	1	-	-	-
514. Zinc	1	88	110	100
601. Total Cyanides	-	-	-	-
602. Total Phenols	45	50	30	40.9

CLASSICAL PARAMETER ANALYSIS

FRANKLIN

SAMPLE NUMBER	403		412		423			Avg.
pH	6.6		6.6		6.5			6.6
T (°C)	17.6		17.8		19.7			18.4
Ammonia	3.5		7.0		4.0			4.7
Oil and Grease	50*		20*		30*			34
TSS	35		75		30			45
TOC	49		52		39			46
COD	180		210		130			170
BOD	45		115		30			60

*Based on average of Franklin and Victoria samples.

PRIORITY POLLUTANT CHEMICAL ANALYSIS

HILLSIDE

SAMPLE NUMBER	404	413	424	Avg.
112. Trans-1,2-dichloroethylene	-	-	-	-
113. Chloroform	3	5	6	4.6
114. 1,2-Dichloroethane	-	-	-	-
115. 1,1,1-Trichloroethane	-	3	-	0.9
117. Bromodichloromethane	-	-	-	-
120. Trichloroethylene	-	-	-	-
121. Benzene	-	-	-	-
127. 1,1,2,2-Tetrachloroethylene	-	3	2	1.6
128. Toluene	-	-	-	-
130. Ethyl benzene	-	-	-	-
203. Phenol	-	-	-	-
207. 4-Chloro-3-Cresol	-	-	-	-
301. Dichlorobenzenes	-	-	-	-
310. Nitrobenzene	-	-	-	-
312. 1,2,4-Trichlorobenzene	-	-	-	-
315. Naphthalene	-	-	-	-
326. Diethyl phthalate	-	-	-	-
331. Anthracene/Phenanthrene	-	-	-	-
333. Di-n-butyl phthalate	-	-	-	-
334. Fluoranthene	-	-	-	-
337. Butyl benzyl phthalate	-	-	-	-
338. Bis (2-ethyl hexyl) phthalate	-	-	-	-
502. Arsenic	-	-	-	-
504. Cadmium	-	-	-	-
505. Chromium	-	-	40	13.3
506. Copper	22	38	65	41.1
507. Lead	-	17	-	5.2
508. Manganese	215	190	190	199
509. Mercury	-	-	-	-
510. Nickel	-	-	-	-
511. Selenium	2	-	-	0.7
512. Silver	-	-	-	-
514. Zinc	37	59	55	49.6
601. Total Cyanides	-	-	-	-
602. Total Phenols	31	19	15	22.1

CLASSICAL WASTEWATER PARAMETER ANALYSIS

HILLSIDE

SAMPLE NUMBER	404		413		424			Avg.
pH	6.5		6.6		6.0			6.4
T (°C)	16.3		16.4		18.3			17
Ammonia	2.5		2.5		2.5			2.5
Oil and Grease	20		15		10			15
TSS	20		20		15			18
TOC	23		33		34			30
COD	90		120		130			112
BOD	10		20		20			16

PRIORITY POLLUTANT CHEMICAL ANALYSIS

CLOVER

SAMPLE NUMBER	405	414	425	Avg.
112. Trans-1,2-dichloroethylene	-	-	-	-
113. Chloroform	7	12	8	9.0
114. 1,2-Dichloroethane	-	-	-	-
115. 1,1,1-Trichloroethane	-	-	-	-
117. Bromodichloromethane	-	-	-	-
120. Trichloroethylene	-	-	-	-
121. Benzene	-	-	-	-
127. 1,1,2,2-Tetrachloroethylene	10	9	-	6.3
128. Toluene	14	4	-	6.0
130. Ethyl benzene	-	2	-	0.7
203. Phenol	14	16	11	13.7
207. 4-Chloro-3-Cresol	-	-	-	-
301. Dichlorobenzenes	-	-	-	-
310. Nitrobenzene	-	-	-	-
312. 1,2,4-Trichlorobenzene	-	-	-	-
315. Naphthalene	-	-	-	-
326. Diethyl phthalate	-	-	-	-
331. Anthracene/Phenanthrene	-	-	-	-
333. Di-n-butyl phthalate	28	13	11	17.3
334. Fluoranthene	-	-	-	-
337. Butyl benzyl phthalate	11	26	-	12.3
338. Bis (2-ethyl hexyl) phthalate	-	-	-	-
502. Arsenic	-	-	-	-
504. Cadmium	-	-	-	-
505. Chromium	-	-	-	-
506. Copper	80	105	100	95.1
507. Lead	24	29	21	24.7
508. Manganese	33	24	18	25.0
509. Mercury	-	-	-	-
510. Nickel	19	-	-	6.3
511. Selenium	-	-	-	-
512. Silver	-	-	-	-
514. Zinc	240	320	95	218
601. Total Cyanides	-	-	-	-
602. Total Phenols	45	32	39	38.6

CLASSICAL WASTEWATER PARAMETER ANALYSIS

CLOVER

SAMPLE NUMBER	405		414		425			Avg.
pH	6.6		6.3		6.3			6.4
T (°C)	22.9		23.0		20.0			15.9
Ammonia	7.7		7.8		7.1			7.5
Oil and Grease	80		240		55			125
TSS	215		95		210			173
TOC	200		170		170			180
COD	920		960		880			920
BOD	515		85		455			351

PRIORITY POLLUTANT CHEMICAL ANALYSIS

POTTER

SAMPLE NUMBER	406	415	426	AVG.
112. Trans-1,2-dichloroethylene	-	-	-	-
113. Chloroform	5	4	4	4.3
114. 1,2-Dichloroethane	-	-	-	-
115. 1,1,1-Trichloroethane	5	12	5	7.1
117. Bromodichloromethane	-	-	-	-
120. Trichloroethylene	-	1	-	0.3
121. Benzene	-	-	-	-
127. 1,1,2,2-Tetrachloroethylene	53	22	6	25.0
128. Toluene	1	11	10	7.5
130. Ethyl benzene	-	2	-	0.6
203. Phenol	-	-	-	-
207. 4-Chloro-3-Cresol	-	-	-	-
301. Dichlorobenzenes	11	11	-	6.6
310. Nitrobenzene	-	-	-	-
312. 1,2,4-Trichlorobenzene	11	-	-	3.7
315. Naphthalene	10	-	-	3.1
326. Diethyl phthalate	-	-	-	-
331. Anthracene/Phenanthrene	-	-	-	-
333. Di-n-butyl phthalate	-	-	-	-
334. Fluoranthene	-	-	-	-
337. Butyl benzyl phthalate	15	-	-	4.6
338. Bis (2-ethyl hexyl) phthalate	14	-	-	4.3
502. Arsenic	-	-	3	1.2
504. Cadmium	-	4	-	1.2
505. Chromium	150	78	37	83.5
506. Copper	69	82	120	93.3
507. Lead	30	32	100	58.7
508. Manganese	140	120	130	130
509. Mercury	-	-	-	-
510. Nickel	40	52	23	36.7
511. Selenium	-	-	-	-
512. Silver	NA	NA	NA	
514. Zinc	160	170	210	183
601. Total Cyanides	-	-	-	-
602. Total Phenols	26	32	-	17.3

CLASSICAL WASTEWATER PARAMETER ANALYSIS

POTTER

SAMPLE NUMBER	406		415		426			Avg.
pH	6.6		6.2		6.4			6.4
T (°C)	19.8		20.3		21.3			20.5
Ammonia	7.8		10		5.8			7.6
Oil and Grease	40		400		25			140
TSS	60		70		45			57
TOC	49		67		53			56
COD	240		340		260			277
BOD	80		95		55			74

PRIORITY POLLUTANT CHEMICAL ANALYSIS

SENECA

SAMPLE NUMBER	407	416	427	Avg.
112. Trans-1,2-dichloroethylene	-	2	-	0.7
113. Chloroform	3	7	5	5.1
114. 1,2-Dichloroethane	-	3	-	1.0
115. 1,1,1-Trichloroethane	-	-	-	-
117. Bromodichloromethane	-	-	-	-
120. Trichloroethylene	-	-	-	-
121. Benzene	-	19	-	6.2
127. 1,1,2,2-Tetrachloroethylene	8	33	13	18.0
128. Toluene	-	38	-	12.4
130. Ethyl benzene	-	3	-	1.0
203. Phenol	-	-	-	-
207. 4-Chloro-3-Cresol	-	-	-	-
301. Dichlorobenzenes	-	-	-	-
310. Nitrobenzene	-	-	-	-
312. 1,2,4-Trichlorobenzene	-	-	-	-
315. Naphthalene	-	-	-	-
326. Diethyl phthalate	-	-	-	-
331. Anthracene/Phenanthrene	-	-	-	-
333. Di-n-butyl phthalate	-	-	-	-
334. Fluoranthene	-	-	-	-
337. Butyl benzyl phthalate	-	11	-	3.6
338. Bis (2-ethyl hexyl) phthalate	-	-	-	-
502. Arsenic	4	3	4	3.7
504. Cadmium	-	-	-	-
505. Chromium	-	-	35	13.1
506. Copper	69	49	82	67.3
507. Lead	-	17	-	5.6
508. Manganese	410	290	310	333
509. Mercury	9	-	-	2.7
510. Nickel	10	-	6	5.2
511. Selenium	2	-	-	0.6
512. Silver	7	2	2	3.5
514. Zinc	80	51	96	76.5
601. Total Cyanides	-	-	-	-
602. Total Phenols	36	38	106	62.9

CLASSICAL WASTEWATER PARAMETER ANALYSIS

SENECA

SAMPLE NUMBER	407		416		427			Avg.
pH	6.2		6.1		6.5			6.3
T (°C)	19.8		21.5		21.4			20.9
Ammonia	10		9.5		8.2			9.2
Oil and Grease	30		15		15			20
TSS	115		45		35			62
TOC	84		64		72			73
COD	480		250		260			322
BOD	145		90		75			101

PRIORITY POLLUTANT CHEMICAL ANALYSIS

TAP 2

SAMPLE NUMBER	408	428					Avg.
112. Trans-1,2-dichloroethylene	-	-					-
113. Chloroform	28	29					28.5
114. 1,2-Dichloroethane	-	-					-
115. 1,1,1-Trichloroethane	-	-					-
117. Bromodichloromethane	5	5					5.0
120. Trichloroethylene	-	-					-
121. Benzene	-	-					-
127. 1,1,2,2-Tetrachloroethylene	-	-					-
128. Toluene	-	-					-
130. Ethyl benzene	-	-					-
203. Phenol	-	-					-
207. 4-Chloro-3-Cresol	-	-					-
301. Dichlorobenzenes	-	-					-
310. Nitrobenzene	-	-					-
312. 1,2,4-Trichlorobenzene	-	-					-
315. Naphthalene	-	-					-
326. Diethyl phthalate	-	-					-
331. Anthracene/Phenanthrene	-	-					-
333. Di-n-butyl phthalate	15	-					7.5
334. Fluoranthene	-	-					-
337. Butyl benzyl phthalate	-	-					-
338. Bis (2-ethyl hexyl) phthalate	-	-					-
502. Arsenic	-	-					-
504. Cadmium	-	-					-
505. Chromium	-	-					-
506. Copper	18	24					21.0
507. Lead	-	-					-
508. Manganese	12	13					12.5
509. Mercury	-	-					-
510. Nickel	-	-					-
511. Selenium	-	-					-
512. Silver	-	-					-
514. Zinc	-	23					11.5
601. Total Cyanides	-	-					-
602. Total Phenols	-	-					-

CLASSICAL WASTEWATER PARAMETER ANALYSIS

TAP 2

SAMPLE NUMBER	408				428			Avg.
pH	5.7				6.3			6.0
T (°C)	18.8				20.0			19.4
Ammonia	-				-			-
Oil and Grease	-				-			-
TSS	-				-			-
TOC	-				-			-
COD	-				-			-
BOD	-				-			-

PRIORITY POLLUTANT CHEMICAL ANALYSIS

TUNXIS

SAMPLE NUMBER	409	417	429	Avg.
112. Trans-1,2-dichloroethylene	-	-	-	-
113. Chloroform	-	-	-	-
114. 1,2-Dichloroethane	-	-	-	-
115. 1,1,1-Trichloroethane	-	-	-	-
117. Bromodichloromethane	-	-	-	-
120. Trichloroethylene	-	-	-	-
121. Benzene	-	-	-	-
127. 1,1,2,2-Tetrachloroethylene	1	-	-	0.3
128. Toluene	-	-	-	-
130. Ethyl benzene	-	-	-	-
203. Phenol	-	-	-	-
207. 4-Chloro-3-Cresol	-	-	-	-
301. Dichlorobenzenes	-	-	-	-
310. Nitrobenzene	-	-	-	-
312. 1,2,4-Trichlorobenzene	-	-	-	-
315. Naphthalene	-	-	-	-
326. Diethyl phthalate	-	-	-	-
331. Anthracene/Phenanthrene	-	9	-	3.0
333. Di-n-butyl phthalate	42	-	-	14.5
334. Fluoranthene	-	-	-	-
337. Butyl benzyl phthalate	-	-	-	-
338. Bis (2-ethyl hexyl) phthalate	-	-	-	-
502. Arsenic	3	5	-	2.5
504. Cadmium	-	-	-	-
505. Chromium	-	-	-	-
506. Copper	54	67	63	61.0
507. Lead	18	-	19	13.2
508. Manganese	65	73	56	64.0
509. Mercury	-	-	-	-
510. Nickel	-	-	-	-
511. Selenium	-	2	-	0.6
512. Silver	-	-	-	-
514. Zinc	40	63	61	54.3
601. Total Cyanides	-	-	-	-
602. Total Phenols	-	-	-	-

CLASSICAL WASTEWATER PARAMETER ANALYSIS

TUNXIS

SAMPLE NUMBER	409		417		429			Avg.
pH	6.4		6.4		6.5			6.4
T (°C)	13.2		14.2		15.4			14.3
Ammonia	6.1		7.6		9.4			7.7
Oil and Grease	45*		12*		2*			20
TSS	25		40		50			39
TOC	79		61		47			62
COD	240		250		180			221
BOD	90		70		65			75

*Based on average of Tunxis and Maple samples.

PRIORITY POLLUTANT CHEMICAL ANALYSIS

BRENTWOOD

SAMPLE NUMBER	410	418	430	Avg.
112. Trans-1,2-dichloroethylene	-	-	-	-
113. Chloroform	2	3	3	2.7
114. 1,2-Dichloroethane	-	-	-	-
115. 1,1,1-Trichloroethane	-	77	5	24.2
117. Bromodichloromethane	-	-	-	-
120. Trichloroethylene	-	-	-	-
121. Benzene	-	-	-	-
127. 1,1,2,2-Tetrachloroethylene	2	-	-	0.7
128. Toluene	-	-	-	-
130. Ethyl benzene	-	-	-	-
203. Phenol	-	-	-	-
207. 4-Chloro-3-Cresol	-	-	-	-
301. Dichlorobenzenes	-	-	-	-
310. Nitrobenzene	16	-	-	5.3
312. 1,2,4-Trichlorobenzene	-	-	-	-
315. Naphthalene	-	-	-	-
326. Diethyl phthalate	14	36	-	15.0
331. Anthracene/Phenanthrene	-	-	-	-
333. Di-n-butyl phthalate	-	11	-	3.2
334. Fluoranthene	5	-	-	1.7
337. Butyl benzyl phthalate	13	14	-	8.3
338. Bis (2-ethyl hexyl) phthalate	-	-	-	-
502. Arsenic	3	3	4	3.4
504. Cadmium	-	48	-	13.9
505. Chromium	-	-	-	-
506. Copper	81	63	58	67.0
507. Lead	22	31	34	29.2
508. Manganese	120	120	120	120
509. Mercury	2	-	-	0.7
510. Nickel	-	6	-	1.7
511. Selenium	-	-	-	-
512. Silver	-	-	-	-
514. Zinc	190	87	87	121
601. Total Cyanides	-	-	-	-
602. Total Phenols	23	27	25	24.9

CLASSICAL PARAMETERS ANALYSIS

BRENTWOOD

SAMPLE NUMBER	410		418		430			Avg.
pH	6.5		6.3		6.6			6.5
T (°C)	17.3		19.7		20.2			19.1
Ammonia	13		11		13			12
Oil and Grease	20		10		20			17
TSS	80		475		70			191
TOC	71		55		67			65
COD	320		250		320			300
BOD	90		210		125			138

APPENDIX E

ANALYTICAL DATA BY CHEMICAL

This appendix contains the analytical data for all chemicals that were detected above the reporting limits. The data are tabulated by chemical and include source information, measured concentrations, average concentrations and percent of samples in which each was observed.

112 TRANS-1,2-DICHLOROETHYLENE

SITES	TUES-WED	THUR-FRI	SAT-SUN	AVERAGE WHEN PRESENT	AVERAGE	FRACTION PRESENT
S FRANKLIN	0	0	0	.0	.0	.00
O HILLSIDE	0	0	0	.0	.0	.00
U TUNXIS	0	0	0	.0	.0	.00
R BRENTWOOD	0	0	0	.0	.0	.00
C CLOVER	0	0	0	.0	.0	.00
E POTTER	0	0	0	.0	.0	.00
S SENECA	0	2	0	2.0	.7	.33
-	0	0	0	.0	.0	.00
TAPWATER1	0	0	0	.0	.0	.00
TAPWATER2	0	0	0	.0	.0	.00
INFLUENT	0	0	0	.0	.0	.00

113 CHLOROFORM

SITES	TUES-WED	THUR-FRI	SAT-SUN	AVERAGE WHEN PRESENT	AVERAGE	FRACTION PRESENT
S FRANKLIN	3	4	3	3.3	3.3	1.00
O HILLSIDE	3	5	6	4.7	4.7	1.00
U TUNXIS	0	0	0	.0	.0	.00
R BRENTWOOD	2	3	3	2.7	2.7	1.00
C CLOVER	7	12	8	9.0	9.0	1.00
E POTTER	5	4	4	4.3	4.3	1.00
S SENECA	3	7	5	5.0	5.0	1.00
-	24	0	24	24.0	24.0	1.00
TAPWATER1	20	0	29	28.5	28.5	1.00
TAPWATER2	4	4	3	3.7	3.7	1.00
INFLUENT						

114 1,2-DICHLOROETHANE

SITES	TUES-WED	THUR-FRI	SAT-SUN	AVERAGE WHEN PRESENT	AVERAGE	FRACTION PRESENT
S FRANKLIN	0	0	0	.0	.0	.00
O HILLSIDE	0	0	0	.0	.0	.00
U TUNXIS	0	0	0	.0	.0	.00
R BRENTWOOD	0	0	0	.0	.0	.00
C CLOVER	0	0	0	.0	.0	.00
E POTTER	0	0	0	.0	.0	.00
S SENECA	0	3	0	3.0	1.0	.33
-	0	0	0	.0	.0	.00
TAPWATER1	0	0	0	.0	.0	.00
TAPWATER2	0	0	0	.0	.0	.00
INFLUENT	0	0	0	.0	.0	.00

115 1,1,1-TRICHLOROETHANE

SITES	TUES-WED	THUR-FRI	SAT-SUN	AVERAGE WHEN PRESENT	AVERAGE	FRACTION PRESENT
3 FRANKLIN	0	0	0	.0	.0	.00
0 HILLSIDE	0	3	0	3.0	1.0	.33
U TUNXIS	0	0	0	.0	.0	.00
R BRENTWOOD	0	77	5	41.0	27.3	.67
C CLOVER	0	0	0	.0	.0	.00
E POTTER	5	12	5	7.3	7.3	1.00
S SENECA	0	0	0	.0	.0	.00
- TAPWATER1	0	0	0	.0	.0	.00
TAPWATER2	10	13	0	10.3	10.3	.00
INFLUENT			0			1.00

117 BROMODICHLOROMETHANE

SITES	TUES-WED	THUR-FRI	SAT-SUN	AVERAGE WHEN PRESENT	AVERAGE	FRACTION PRESENT
3 FRANKLIN	0	0	0	.0	.0	.00
0 HILLSIDE	0	0	0	.0	.0	.00
U TUNXIS	0	0	0	.0	.0	.00
R BRENTWOOD	0	0	0	.0	.0	.00
C CLOVER	0	0	0	.0	.0	.00
E POTTER	0	0	0	.0	.0	.00
S SENECA	0	0	0	.0	.0	.00
- TAPWATER1	7	0	3	5.0	5.0	1.00
TAPWATER2	5	0	5	5.0	5.0	1.00
INFLUENT	0	0	0	.0	.0	.00

120 TRICHLOROETHYLENE

SITES	TUES-WED	THUR-FRI	SAT-SUN	AVERAGE WHEN PRESENT	AVERAGE	FRACTION PRESENT
3 FRANKLIN	0	0	0	.0	.0	.00
0 HILLSIDE	0	0	0	.0	.0	.00
U TUNXIS	0	0	0	.0	.0	.00
R BRENTWOOD	0	0	0	.0	.0	.00
C CLOVER	0	1	0	1.0	.3	.33
E POTTER	0	0	0	.0	.0	.00
S SENECA	0	0	0	.0	.0	.00
- TAPWATER1	0	0	0	.0	.0	.00
TAPWATER2	0	16	0	8.7	8.7	.00
INFLUENT	8		2			1.00

121 BENZENE

SITES	TUES-WED	THUR-FRI	SAT-SUN	AVERAGE WHEN PRESENT	FRACTION PRESENT
S FRANKLIN	0	0	0	.0	.00
O HILLSIDE	0	0	0	.0	.00
U TUNXIS	0	0	0	.0	.00
R BRENTWOOD	0	0	0	.0	.00
C CLOVER	0	0	0	.0	.00
E POTTER	0	0	0	.0	.00
S -	0	19	0	.0	.00
SENeca	0		0	19.0	.33
TAPWATER1	0		0	6.3	.00
TAPWATER2	0		0	.0	.00
INFLUENT	0	0	0	.0	.00

127 1,1,2,2-TETRACHLOROETHYLENE

SITES	TUES-WED	THUR-FRI	SAT-SUN	AVERAGE WHEN PRESENT	FRACTION PRESENT
S FRANKLIN	5	5	2	4.0	1.00
O HILLSIDE	0	3	2	2.5	.67
U TUNXIS	1	0	0	1.7	.33
R BRENTWOOD	2	0	0	1.0	.33
C CLOVER	10	9	0	7.3	.67
E POTTER	53	22	6	27.0	1.00
S -	8	33	13	18.0	1.00
SENeca	0		0	.0	.00
TAPWATER1	0		0	.0	.00
TAPWATER2	0		0	.0	.00
INFLUENT	42	30	8	26.7	1.00

128 TOLUENE

SITES	TUES-WED	THUR-FRI	SAT-SUN	AVERAGE WHEN PRESENT	FRACTION PRESENT
S FRANKLIN	3	3	0	3.0	.67
O HILLSIDE	0	0	0	.0	.00
U TUNXIS	0	0	0	.0	.00
R BRENTWOOD	0	0	0	.0	.00
C CLOVER	14	4	0	9.0	.67
E POTTER	1	11	10	7.3	1.00
S -	0	38	0	38.0	.33
SENeca	0		0	.0	.00
TAPWATER1	0		0	.0	.00
TAPWATER2	0		0	.0	.00
INFLUENT	7	34	7	16.0	1.00

SITES

	TUES-WED	THUR-FRI	SAT-SUN	AVERAGE WHEN PRESENT	AVERAGE	FRACTION PRESENT
1	0	0	0	.0	.0	.00
2	0	0	0	.0	.0	.00
3	0	0	0	.0	.0	.00
4	0	0	0	.0	.0	.00
5	0	0	0	.0	.0	.00
6	0	0	0	.0	.0	.00
7	0	0	0	.0	.0	.00
8	0	0	0	.0	.0	.00
9	0	0	0	.0	.0	.00
10	0	0	0	.0	.0	.00
11	0	0	0	.0	.0	.00
12	0	0	0	.0	.0	.00
13	0	0	0	.0	.0	.00
14	0	0	0	.0	.0	.00
15	0	0	0	.0	.0	.00
16	0	0	0	.0	.0	.00
17	0	0	0	.0	.0	.00
18	0	0	0	.0	.0	.00
19	0	0	0	.0	.0	.00
20	0	0	0	.0	.0	.00
21	0	0	0	.0	.0	.00
22	0	0	0	.0	.0	.00
23	0	0	0	.0	.0	.00
24	0	0	0	.0	.0	.00
25	0	0	0	.0	.0	.00
26	0	0	0	.0	.0	.00
27	0	0	0	.0	.0	.00
28	0	0	0	.0	.0	.00
29	0	0	0	.0	.0	.00
30	0	0	0	.0	.0	.00
31	0	0	0	.0	.0	.00
32	0	0	0	.0	.0	.00
33	0	0	0	.0	.0	.00
34	0	0	0	.0	.0	.00
35	0	0	0	.0	.0	.00
36	0	0	0	.0	.0	.00
37	0	0	0	.0	.0	.00
38	0	0	0	.0	.0	.00
39	0	0	0	.0	.0	.00
40	0	0	0	.0	.0	.00
41	0	0	0	.0	.0	.00
42	0	0	0	.0	.0	.00
43	0	0	0	.0	.0	.00
44	0	0	0	.0	.0	.00
45	0	0	0	.0	.0	.00
46	0	0	0	.0	.0	.00
47	0	0	0	.0	.0	.00
48	0	0	0	.0	.0	.00
49	0	0	0	.0	.0	.00
50	0	0	0	.0	.0	.00
51	0	0	0	.0	.0	.00
52	0	0	0	.0	.0	.00
53	0	0	0	.0	.0	.00
54	0	0	0	.0	.0	.00
55	0	0	0	.0	.0	.00
56	0	0	0	.0	.0	.00
57	0	0	0	.0	.0	.00
58	0	0	0	.0	.0	.00
59	0	0	0	.0	.0	.00
60	0	0	0	.0	.0	.00
61	0	0	0	.0	.0	.00
62	0	0	0	.0	.0	.00
63	0	0	0	.0	.0	.00
64	0	0	0	.0	.0	.00
65	0	0	0	.0	.0	.00
66	0	0	0	.0	.0	.00
67	0	0	0	.0	.0	.00
68	0	0	0	.0	.0	.00
69	0	0	0	.0	.0	.00
70	0</					

203 PHENOL

SITES	TUES-WED	THUR-FRI	SAT-SUN	AVERAGE WHEN PRESENT	AVERAGE	FRACTION PRESENT
3 FRANKLIN	0	0	0	.0	.0	.00
0 HILLSIDE	0	0	0	.0	.0	.00
U TUNXIS	0	0	0	.0	.0	.00
R BRENTWOOD	0	0	0	.0	.0	.00
C CLOVER	14	16	11	13.7	13.7	1.00
E POTTER	0	0	0	.0	.0	.00
S -	0	0	0	.0	.0	.00
S SENeca	0	0	0	.0	.0	.00
TAPWATER1	0	0	0	.0	.0	.00
TAPWATER2	0	0	0	.0	.0	.00
INFLUENT	0	0	0	.0	.0	.00

207 4-CHLORO-3-CRESOL

SITES	TUES-WED	THUR-FRI	SAT-SUN	AVERAGE WHEN PRESENT	AVERAGE	FRACTION PRESENT
3 FRANKLIN	0	0	0	.0	.0	.00
0 HILLSIDE	0	0	0	.0	.0	.00
U TUNXIS	0	0	0	.0	.0	.00
R BRENTWOOD	0	0	0	.0	.0	.00
C CLOVER	0	0	0	.0	.0	.00
E POTTER	0	0	0	.0	.0	.00
S -	0	0	0	.0	.0	.00
S SENeca	0	0	0	.0	.0	.00
TAPWATER1	0	0	0	.0	.0	.00
TAPWATER2	0	0	0	.0	.0	.00
INFLUENT	11	0	0	11.0	3.7	.33

301 DICHLOROBENZENES

SITES	TUES-WED	THUR-FRI	SAT-SUN	AVERAGE WHEN PRESENT	AVERAGE	FRACTION PRESENT
3 FRANKLIN	0	0	0	.0	.0	.00
0 HILLSIDE	0	0	0	.0	.0	.00
U TUNXIS	0	0	0	.0	.0	.00
R BRENTWOOD	0	0	0	.0	.0	.00
C CLOVER	0	0	0	.0	.0	.00
E POTTER	11	11	0	11.0	7.3	.67
S SENECA	0	0	0	.0	.0	.00
- TAPWATER1	0	0	0	.0	.0	.00
TAPWATER2	0	0	0	.0	.0	.00
INFLUENT	15	10	15	13.3	13.3	1.00

310 NITROBENZENE

SITES	TUES-WED	THUR-FRI	SAT-SUN	AVERAGE WHEN PRESENT	AVERAGE	FRACTION PRESENT
3 FRANKLIN	0	0	0	.0	.0	.00
0 HILLSIDE	0	0	0	.0	.0	.00
U TUNXIS	0	0	0	.0	.0	.00
R BRENTWOOD	16	0	0	16.0	5.3	.33
C CLOVER	0	0	0	.0	.0	.00
E POTTER	0	0	0	.0	.0	.00
S SENECA	0	0	0	.0	.0	.00
- TAPWATER1	0	0	0	.0	.0	.00
TAPWATER2	0	0	0	.0	.0	.00
INFLUENT	0	0	0	.0	.0	.00

312 1,2,4-TRICHLOROBENZENE

SITES	TUES-WED	THUR-FRI	SAT-SUN	AVERAGE WHEN PRESENT	AVERAGE	FRACTION PRESENT
3 FRANKLIN	0	10	0	10.0	3.3	.33
0 HILLSIDE	0	0	0	.0	.0	.00
U TUNXIS	0	0	0	.0	.0	.00
H BRENTWOOD	0	0	0	.0	.0	.00
C CLOVER	0	0	0	.0	.0	.00
E POTTER	11	0	0	11.0	3.7	.33
S SENECA	0	0	0	.0	.0	.00
- TAPWATER1	0	0	0	.0	.0	.00
TAPWATER2	0	0	0	.0	.0	.00
INFLUENT	0	0	0	.0	.0	.00

315 NAPHTHALENE

SITES	TUES-WED	THUR-FRI	SAT-SUN	AVERAGE WHEN PRESENT	AVERAGE	FRACTION PRESENT
3 FRANKLIN	0	18	0	18.0	6.0	.33
0 HILLSIDE	0	0	0	.0	.0	.00
U TUNXIS	0	0	0	.0	.0	.00
R BRENTWOOD	0	0	0	.0	.0	.00
C CLOVER	0	0	0	.0	.0	.00
E POTTER	10	0	0	10.0	3.3	.33
S SENECA	0	0	0	.0	.0	.00
- TAPWATER1	0	0	0	.0	.0	.00
TAPWATER2	0	0	0	.0	.0	.00
INFLUENT	0	0	0	.0	.0	.00

326 DIETHYL PHTHALATE

SITES	TUES-WED	THUR-FRI	SAT-SUN	AVERAGE WHEN PRESENT	AVERAGE	FRACTION PRESENT
3 FRANKLIN	0	0	0	.0	.0	.00
0 HILLSIDE	0	0	0	.0	.0	.00
U TUNXIS	0	0	0	.0	.0	.00
R BRENTWOOD	14	36	0	25.0	16.7	.67
C CLOVER	0	0	0	.0	.0	.00
E POTTER	0	0	0	.0	.0	.00
S SENECA	0	0	0	.0	.0	.00
- TAPWATER1	0	0	0	.0	.0	.00
TAPWATER2	0	0	0	.0	.0	.00
INFLUENT	11	0	0	11.0	3.7	.33

331 ANTHRACENE/PHENANTHRENE

SITES	TUES-WED	THUR-FRI	SAT-SUN	AVERAGE WHEN PRESENT	AVERAGE	FRACTION PRESENT
3 FRANKLIN	0	0	0	.0	.0	.00
0 HILLSIDE	0	0	0	.0	.0	.00
U TUNXIS	0	9	0	9.0	3.0	.33
R BRENTWOOD	0	0	0	.0	.0	.00
C CLOVER	0	0	0	.0	.0	.00
E POTTER	0	0	0	.0	.0	.00
S SENECA	0	0	0	.0	.0	.00
- TAPWATER1	0	0	0	.0	.0	.00
TAPWATER2	0	0	0	.0	.0	.00
INFLUENT	0	0	0	.0	.0	.00

333 DI-N-BUTYL PHTHALATE

SITES	TUES-WED	THUR-FRI	SAT-SUN	AVERAGE WHEN PRESENT	AVERAGE	FRACTION PRESENT
S FRANKLIN	0	0	0	.0	.0	.00
O HILLSIDE	0	0	0	.0	.0	.00
U TUNXIS	42	0	0	42.0	14.0	.33
R BRENTWOOD	0	11	0	11.0	3.7	.33
C CLOVER	28	13	11	17.3	17.3	1.00
E POTTER	0	0	0	.0	.0	.00
S SENECA	0	0	0	.0	.0	.00
TAPWATER1	0	0	0	.0	.0	.00
TAPWATER2	15	0	0	15.0	7.5	.50
INFLUENT	0	0	12	12.0	4.0	.33

334 FLUORANTHENE

SITES	TUES-WED	THUR-FRI	SAT-SUN	AVERAGE WHEN PRESENT	AVERAGE	FRACTION PRESENT
S FRANKLIN	0	0	0	.0	.0	.00
O HILLSIDE	0	0	0	.0	.0	.00
U TUNXIS	0	0	0	.0	.0	.00
R BRENTWOOD	5	0	0	5.0	1.7	.33
C CLOVER	0	0	0	.0	.0	.00
E POTTER	0	0	0	.0	.0	.00
S SENECA	0	0	0	.0	.0	.00
TAPWATER1	0	0	0	.0	.0	.00
TAPWATER2	0	0	0	.0	.0	.00
INFLUENT	0	0	0	.0	.0	.00

337 BUTYL BENZYL PHTHALATE

SITES	TUES-WED	THUR-FRI	SAT-SUN	AVERAGE WHEN PRESENT	AVERAGE	FRACTION PRESENT
S FRANKLIN	0	0	0	.0	.0	.00
O HILLSIDE	0	0	0	.0	.0	.00
U TUNXIS	0	0	0	.0	.0	.00
R BRENTWOOD	13	14	0	13.5	9.0	.67
C CLOVER	11	26	0	18.5	12.3	.67
E POTTER	15	0	0	15.0	5.0	.33
S SENECA	0	11	0	11.0	3.7	.33
TAPWATER1	0	0	0	.0	.0	.00
TAPWATER2	0	0	0	.0	.0	.00
INFLUENT	0	0	0	.0	.0	.00

338 BIS(2-ETHYLMETHYL)PHTHALATE		TUES-WED	THUR-FRI	SAT-SUN	AVERAGE WHEN PRESENT	AVERAGE	FRACTION PRESENT
SITES							
3 FRANKLIN		0	0	0	0	0	0
0 HILLSIDE		0	0	0	0	0	0
U TUNXIS		0	0	0	0	0	0
R BRENTWOOD		0	0	0	0	0	0
C CLOVER		0	0	0	0	0	0
E POTTER		14	0	0	14	4.7	33
S SENECA		0	0	0	0	0	0
- TAPWATER1		0	0	0	0	0	0
TAPWATER2		0	0	0	0	0	0
INFLUENT		0	0	0	0	0	0

502 ARSENIC		TUES-WED		THUR-FRI		SAT-SUN		AVERAGE WHEN PRESENT		FRACTION PRESENT	
SITES											
3	FRANKLIN	0	0	0	0	0	0	0	0	0	0
0	HILLSIDE	0	0	0	0	0	0	0	0	0	0
U	TUNXIS	3	3	5	5	0	0	4	2.7	0	0
R	BRENTWOOD	3	3	3	3	4	4	3	3.3	1.00	0
C	CLOVER	0	0	0	0	0	0	0	0	0	0
E	POTTER	0	0	0	0	3	3	3	1.0	0	0
S	SENECA	4	4	3	3	4	4	3.7	3.7	1.00	0
-	TAPWATER1	0	0	0	0	0	0	0	0	0	0
	TAPWATER2	0	0	0	0	0	0	0	0	0	0
	INFLUENT	3	3	3	3	0	0	3	2.0	0	0

504 CADMIUM		TUES-WED		THUR-FRI		SAT-SUN		AVERAGE WHEN PRESENT		FRACTION PRESENT	
SITES											
3	FRANKLIN	0	0	0	0	0	0	0	0	0	0
0	HILLSIDE	0	0	0	0	0	0	0	0	0	0
U	TUNXIS	0	0	0	0	0	0	0	0	0	0
R	BRENTWOOD	0	0	4	4	0	0	4	16.0	0	0
C	CLOVER	0	0	0	0	0	0	0	0	0	0
E	POTTER	0	0	4	4	0	0	4	1.3	0	0
S	SENECA	0	0	0	0	0	0	0	0	0	0
-	TAPWATER1	0	0	0	0	0	0	0	0	0	0
	TAPWATER2	0	0	0	0	0	0	0	0	0	0
	INFLUENT	0	0	0	0	0	0	0	0	0	0

505 CHROMIUM		TUES-WED		THUR-FRI		SAT-SUN		AVERAGE WHEN PRESENT		FRACTION PRESENT	
SITES											
3	FRANKLIN	84	84	190	190	0	0	0	91.3	0	0
0	HILLSIDE	0	0	0	0	0	0	0	13.3	0	0
U	TUNXIS	0	0	0	0	0	0	0	0	0	0
R	BRENTWOOD	0	0	0	0	0	0	0	0	0	0
C	CLOVER	0	0	0	0	0	0	0	0	0	0
E	POTTER	150	150	78	78	37	37	88.3	88.3	1.00	0
S	SENECA	0	0	0	0	35	35	35.0	11.7	0	0
-	TAPWATER1	0	0	0	0	0	0	0	0	0	0
	TAPWATER2	0	0	0	0	0	0	0	0	0	0
	INFLUENT	64	64	86	86	48	48	66.0	66.0	1.00	0

506 COPPER

SITES	TUES-WED	THUR-FRI	SAT-SUN	AVERAGE WHEN PRESENT	AVERAGE	FRACTION PRESENT
3 FRANKLIN	75	54	91	73.3	73.3	1.00
0 HILLSIDE	22	38	65	41.7	41.7	1.00
U TUNXIS	54	67	63	61.3	61.3	1.00
R BRENTWOOD	81	63	58	67.3	67.3	1.00
C CLOVER	80	105	100	95.0	95.0	1.00
E POTTER	69	82	120	90.3	90.3	1.00
S SENECA	69	49	82	66.7	66.7	1.00
- TAPWATER1	75		110	92.5	92.5	1.00
TAPWATER2	18		24	21.0	21.0	1.00
INFLUENT	96	130	67	97.7	97.7	1.00

507 LEAD

SITES	TUES-WED	THUR-FRI	SAT-SUN	AVERAGE WHEN PRESENT	AVERAGE	FRACTION PRESENT
3 FRANKLIN	45	29	57	43.7	43.7	1.00
0 HILLSIDE	0	17	0	17.0	5.7	.33
U TUNXIS	18	0	19	18.5	12.3	.67
R BRENTWOOD	22	31	34	29.0	29.0	1.00
C CLOVER	24	29	21	24.7	24.7	1.00
E POTTER	30	32	100	54.0	54.0	1.00
S SENECA	0	17	0	17.0	5.7	.33
- TAPWATER1	0		0	.0	.0	.00
TAPWATER2	0		0	.0	.0	.00
INFLUENT	30	32	44	35.3	35.3	1.00

508 MANGANESE

SITES	TUES-WED	THUR-FRI	SAT-SUN	AVERAGE WHEN PRESENT	AVERAGE	FRACTION PRESENT
3 FRANKLIN	79	80	78	79.0	79.0	1.00
0 HILLSIDE	215	190	190	196.3	198.3	1.00
U TUNXIS	65	73	56	64.7	64.7	1.00
R BRENTWOOD	120	120	120	120.0	120.0	1.00
C CLOVER	33	24	18	25.0	25.0	1.00
E POTTER	140	120	130	130.0	130.0	1.00
S SENECA	410	290	310	336.7	336.7	1.00
- TAPWATER1	0		0	.0	.0	.00
TAPWATER2	12		13	12.5	12.5	1.00
INFLUENT	170	160	145	158.3	158.3	1.00

509 MERCURY

SITES	TUES-WED	THUR-FRI	SAT-SUN	AVERAGE WHEN PRESENT	AVERAGE	FRACTION PRESENT
3 FRANKLIN	0	0	0	.0	.0	.00
0 HILLSIDE	0	0	0	.0	.0	.00
U TUNXIS	0	0	0	.0	.0	.00
R BRENTWOOD	2	0	0	2.0	.7	.33
C CLOVER	0	0	0	.0	.0	.00
E POTTER	0	0	0	.0	.0	.00
S SENECA	9	0	0	9.0	3.0	.33
- TAPWATER1	0	0	0	.0	.0	.00
TAPWATER2	0	0	0	.0	.0	.00
INFLUENT	0	0	0	.0	.0	.00

510 NICKEL

SITES	TUES-WED	THUR-FRI	SAT-SUN	AVERAGE WHEN PRESENT	AVERAGE	FRACTION PRESENT
3 FRANKLIN	3	6	0	4.5	3.0	.67
0 HILLSIDE	0	0	0	.0	.0	.00
U TUNXIS	0	0	0	.0	.0	.00
R BRENTWOOD	0	6	0	6.0	2.0	.33
C CLOVER	19	0	0	19.0	6.3	.33
E POTTER	40	52	23	38.3	38.3	1.00
S SENECA	10	0	6	8.0	5.3	.67
- TAPWATER1	0	0	0	.0	.0	.00
TAPWATER2	0	35	0	.0	.0	.00
INFLUENT	52	0	19	35.3	35.3	1.00

511 SELENIUM

SITES	TUES-WED	THUR-FRI	SAT-SUN	AVERAGE WHEN PRESENT	AVERAGE	FRACTION PRESENT
3 FRANKLIN	0	0	0	.0	.0	.00
0 HILLSIDE	2	0	0	2.0	.7	.33
U TUNXIS	0	2	0	2.0	.7	.33
R BRENTWOOD	0	0	0	.0	.0	.00
C CLOVER	0	0	0	.0	.0	.00
E POTTER	0	0	0	.0	.0	.00
S SENECA	2	0	0	2.0	.7	.33
- TAPWATER1	0	0	0	.0	.0	.00
TAPWATER2	0	0	0	.0	.0	.00
INFLUENT	0	0	0	.0	.0	.00

512 SILVER									
SITES	TUES-MED	THUR-FRI	SAT-SUN	AVERAGE WHEN PRESENT	AVERAGE	FRACTION PRESENT			
3 FRANKLIN	0	0	0	-0	-0	-00			
0 HILLSIDE	0	0	0	-0	-0	-00			
U TUNKIS	0	0	0	-0	-0	-00			
R BRENTWOOD	0	0	0	-0	-0	-00			
C CLOVER	-1	-1	-1	-3.0	-1.0	-00			
E POTTER	7	2	2	3.7	3.7	1.00			
S SENECA	0	0	0	-0	-0	-00			
- TAPWATER1	0	3	0	-0	-0	-00			
TAPWATER2	0	0	0	-0	-0	-00			
INFLUENT	7	0	0	5.0	3.3	.67			

514 ZINC									
SITES	TUES-MED	THUR-FRI	SAT-SUN	AVERAGE WHEN PRESENT	AVERAGE	FRACTION PRESENT			
3 FRANKLIN	100	88	110	99.3	99.3	1.00			
0 HILLSIDE	37	59	55	50.3	50.3	1.00			
U TUNKIS	40	63	61	54.7	54.7	1.00			
R BRENTWOOD	190	87	87	121.3	121.3	1.00			
C CLOVER	240	320	95	218.3	218.3	1.00			
E POTTER	160	170	210	180.0	180.0	1.00			
S SENECA	80	51	96	75.7	75.7	1.00			
- TAPWATER1	11	0	29	20.0	20.0	1.00			
TAPWATER2	0	0	23	23.0	11.5	.50			
INFLUENT	180	120	170	156.7	156.7	1.00			

601 TOTAL CYANIDES

SITES	TUES-WED	THUR-FRI	SAT-SUN	AVERAGE WHEN PRESENT	AVERAGE	FRACTION PRESENT
3 FRANKLIN	0	0	0	0	0	0.00
0 HILLSIDE	0	0	0	0	0	0.00
U TUNXIS	0	0	0	0	0	0.00
R BRENTWOOD	0	0	0	0	0	0.00
C CLOVER	0	0	0	0	0	0.00
E POTTER	0	0	0	0	0	0.00
S SENECA	0	0	0	0	0	0.00
- TAPWATER1	0	0	0	0	0	0.00
TAPWATER2	0	0	0	0	0	0.00
INFLUENT	12	0	0	12.0	4.0	0.33

602 TOTAL PHENOLS

SITES	TUES-WED	THUR-FRI	SAT-SUN	AVERAGE WHEN PRESENT	AVERAGE	FRACTION PRESENT
3 FRANKLIN	45	50	30	41.7	41.7	1.00
0 HILLSIDE	31	19	15	21.7	21.7	1.00
U TUNXIS	0	0	0	0	0	0.00
R BRENTWOOD	23	27	25	25.0	25.0	1.00
C CLOVER	45	32	39	38.7	38.7	1.00
E POTTER	26	32	0	29.0	19.3	0.67
S SENECA	36	38	106	60.0	60.0	1.00
- TAPWATER1	0	0	0	0	0	0.00
TAPWATER2	0	0	0	0	0	0.00
INFLUENT	52	49	56	52.3	52.3	1.00

701 PH

SITES	TUES-WED	THUR-FRI	SAT-SUN	AVERAGE WHEN PRESENT	AVERAGE	FRACTION PRESENT
S FRANKLIN	7	7	7	6.6	6.6	1.00
O HILLSIDE	7	7	6	6.4	6.4	1.00
U TUNXIS	6	6	7	6.4	6.4	1.00
R BRENTWOOD	7	6	7	6.5	6.5	1.00
C CLOVER	7	6	6	6.4	6.4	1.00
E POTTER	7	6	6	6.4	6.4	1.00
S SENECA	6	6	7	6.3	6.3	1.00
- TAPWATER1	6		7	6.4	6.4	1.00
TAPWATER2	6		6	6.0	6.0	1.00
INFLUENT	7	7	7	6.6	6.6	1.00

702 T (C)

SITES	TUES-WED	THUR-FRI	SAT-SUN	AVERAGE WHEN PRESENT	AVERAGE	FRACTION PRESENT
S FRANKLIN	18	18	20	18.4	18.4	1.00
O HILLSIDE	16	16	18	17.0	17.0	1.00
U TUNXIS	13	14	15	14.3	14.3	1.00
R BRENTWOOD	17	20	20	19.1	19.1	1.00
C CLOVER	23	23	20	22.0	22.0	1.00
E POTTER	20	20	21	20.5	20.5	1.00
S SENECA	20	22	21	20.9	20.9	1.00
- TAPWATER1	21		20	20.5	20.5	1.00
TAPWATER2	19		20	19.4	19.4	1.00
INFLUENT	21	21	21	20.7	20.7	1.00

703 AMMONIA

SITES	TUES-WED	THUR-FRI	SAT-SUN	AVERAGE WHEN PRESENT	AVERAGE	FRACTION PRESENT
S FRANKLIN	4	7	4	4.8	4.8	1.00
O HILLSIDE	3	3	3	2.5	2.5	1.00
U TUNXIS	6	8	9	7.7	7.7	1.00
R BRENTWOOD	13	11	13	12.3	12.3	1.00
C CLOVER	8	18	7	17.5	17.5	1.00
E POTTER	8	10	6	7.9	7.9	1.00
S SENECA	10	10	8	9.2	9.2	1.00
- TAPWATER1	1		0	.5	.5	1.00
TAPWATER2	0		0	.1	.0	.50
INFLUENT	9	11	8	9.5	9.5	1.00

704 OIL AND GREASE

SITES	TUES-WED	THUR-FRI	SAT-SUN	AVERAGE WHEN PRESENT	AVERAGE	FRACTION PRESENT
S FRANKLIN	50	20	30	33.3	33.3	1.00
O HILLSIDE	20	15	10	15.0	15.0	1.00
U TUNXIS	45	12	2	19.7	19.7	1.00
R BRENTWOOD	20	10	20	16.7	16.7	1.00
C CLOVER	80	240	55	125.0	125.0	1.00
E POTTER	40	400	25	155.0	155.0	1.00
S SENECA	30	15	15	20.0	20.0	1.00
- TAPWATER1	0		0	0	0	0.00
TAPWATER2	0		0	0	0	0.00
INFLUENT	50	65	0	57.5	38.3	.67

705 TSS

SITES	TUES-WED	THUR-FRI	SAT-SUN	AVERAGE WHEN PRESENT	AVERAGE	FRACTION PRESENT
S FRANKLIN	35	75	30	46.7	46.7	1.00
O HILLSIDE	20	20	15	18.3	18.3	1.00
U TUNXIS	25	40	50	38.3	38.3	1.00
R BRENTWOOD	80	475	70	208.3	208.3	1.00
C CLOVER	215	95	210	173.3	173.3	1.00
E POTTER	60	70	45	58.3	58.3	1.00
S SENECA	115	45	35	65.0	65.0	1.00
- TAPWATER1	0		0	0	0	0.00
TAPWATER2	0		0	0	0	0.00
INFLUENT	85	65	80	76.7	76.7	1.00

706 TOC

SITES	TUES-WED	THUR-FRI	SAT-SUN	AVERAGE WHEN PRESENT	AVERAGE	FRACTION PRESENT
S FRANKLIN	49	52	39	46.7	46.7	1.00
O HILLSIDE	23	33	34	30.0	30.0	1.00
U TUNXIS	79	61	47	62.3	62.3	1.00
R BRENTWOOD	71	55	67	64.3	64.3	1.00
C CLOVER	200	170	170	180.0	180.0	1.00
E POTTER	49	67	53	56.3	56.3	1.00
S SENECA	84	64	72	73.3	73.3	1.00
- TAPWATER1	0		1	1.0	.5	.50
TAPWATER2	0		0	0	0	0.00
INFLUENT	50	32	45	42.3	42.3	1.00

707 CDD

SITES	TUES-WED	THUR-FRI	SAT-SUN	AVERAGE WHEN PRESENT	AVERAGE	FRACTION PRESENT
S FRANKLIN	180	210	130	173.3	173.3	1.00
O HILLSIDE	90	120	130	113.3	113.3	1.00
U TUNXIS	240	250	180	223.3	223.3	1.00
R BRENTWOOD	320	250	320	296.7	296.7	1.00
C CLOVER	920	960	880	920.0	920.0	1.00
E POTTER	240	340	260	280.0	280.0	1.00
S SENECA	480	250	260	330.0	330.0	1.00
- TAPWATER1	0		0	.0	.0	.00
TAPWATER2	0		0	.0	.0	.00
INFLUENT	280	100	190	190.0	190.0	1.00

708 BOD

SITES	TUES-WED	THUR-FRI	SAT-SUN	AVERAGE WHEN PRESENT	AVERAGE	FRACTION PRESENT
S FRANKLIN	45	115	30	63.3	63.3	1.00
O HILLSIDE	10	20	20	16.7	16.7	1.00
U TUNXIS	90	70	65	75.0	75.0	1.00
R BRENTWOOD	90	210	125	141.7	141.7	1.00
C CLOVER	515	85	455	351.7	351.7	1.00
E POTTER	80	95	55	76.7	76.7	1.00
S SENECA	145	90	75	103.3	103.3	1.00
- TAPWATER1	0		0	.0	.0	.00
TAPWATER2	0		0	.0	.0	.00
INFLUENT	70	75	60	68.3	68.3	1.00

APPENDIX F

DATA FOR RAIN SAMPLES

This appendix contains the results of the chemical analysis of samples collected during periods of rain at Franklin and Potter (combined sewers) and at the POTW influent.

Table F-1

DATA FOR RAIN SAMPLES

Franklin

Sampling Time (8/18-19/79)	1300	1700	2100	0100	0500
Measured Flow Rate, Lps	288	619	574	252	229
Precipitation,* inches	.04	.36	.12	.10	.05

	Concentration Data, ug/L				
Chromium	12	6	5	5	5
Copper	110	68	56	63	140
Lead	49	45	54	94	30
Manganese	140	95	56	81	110
Nickel	14	8	8	10	9
Zinc	220	145	110	120	130

* Measurements taken at Bradley International Airport.

Table F-2

DATA FOR RAIN SAMPLES

Potter

Sampling Time (8/18-19/79)	1115	1515	1915	2315	0315	0715
Measured Flow Rate, Lps	665	1405	1414	875	850	460
Precipitation,* Inches	<.01	.22	.30	.05	.10	<.01

Concentration Data, $\mu\text{g/L}$

Chromium	45	69	25	24	23	5
Copper	70	170	75	110	140	88
Lead	41	320	49	45	76	8
Manganese	115	160	110	120	120	210
Nickel	13	26	13	9	7	5
Zinc	142	510	160	110	120	110

* Measurements taken at Bradley International Airport.

Table F-3
DATA FOR RAIN SAMPLES
POTW Influent

Sampling Time (8/18-19/79)	1200	1600	2000	0000	0400	0800
Measured Flow Rate, Lps	2672	3329	3198	2803	2672	2124
Precipitation, * Inches	.02	.30	.20	.06	.09	<.01

	Concentration Data, µg/L					
Chromium	50	43	30	39	36	29
Copper	86	100	73	53	43	31
Lead	87	80	10	50	45	31
Manganese	190	130	100	150	170	200
Nickel	13	110	17	11	12	9
Zinc	210	250	110	79	71	45

* Measurements taken at Bradley International Airport.